FM 23-90

FIELD MANUAL

81-MM MORTAR

HEADQUARTERS, DEPARTMENT OF THE ARMY
FEBRUARY 1972

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *31 July 1975*

81–MM MORTAR

FM 23–90, 25 February 1972, is changed as follows:

Page 5, paragraph 7a(2). In line 3, add "Throughout this manual the term "bipod" is used interchangeably with "mount."

Page 8, table 1. Under CHARGE ZONE column for ILLUM M301A3, change "2 to 8" to read "3 to 8."

Page 10, paragraph 11a(2). In line 2, change "two" to read "three."

Page 12. Paragraph 13*a*(4) is superseded as follows:

(4) PD fuze M519, which is a combination of PD fuze M525A1 and a fuze adapter, is a single action type with a direct action firing device for use with cartridges M362 HE and M370 WP.

Page 13, paragraph 13b(3)(a). In line 3, add "M370 WP," after M362 HE.

Page 13, paragraph 13b(4)(a). In line 3, add "and M370 WP" after high-explosive, and change "round" to "rounds."

Page 14, paragraph 13d(2). In line 3, change "2-second intervals;" to read "3-second intervals;"

Page 16. Paragraph 15*e* is superseded as follows:

e. M301A3. The propelling charge consists of a primer, an ignition cartridge and eight wax treated cotton cloth bag increments assembled to the base of the round as issued. Each increment bag has a button hole in each end. The bags are attached to the projectile by engaging the button holes over the kidney shaped projections on the tail boom. Fire these rounds *only* at charge 3 through 8.

Page 20, paragraph 20b(3). In line 12, change "image is tilted." to read "crosshairs are tilted."

Page 23. Paragraph 22*d*(1) is superseded as follows:

(1) *Sight, M53.* Before returning the sight to the carrying case, close the covers on the level vials, fold crank handle into inoperative position, and place the elbow telescope in the left horizontal position. Set the deflection and elevation readings marked on the inside of the carrying case on the sight and place it in the case. The M53 instrument light is stored in the same case, with the rheostat knob down.

Page 26, paragraph 26. In line 1, change "BA–20 batteries" to read "BA–30 batteries."

Page 26. Paragraph 29 is superseded as follows:

29. Aiming Post Light, M14

The M14 aiming post light (fig 15) is used with the M42 or M53 instrument light for night firing. It consists of a brass case for housing two flashlight batteries, a light bulb, and a switch. The light will also work with the one BA–30 battery placed in either end. The light is provided with colored filters and shaded with a hood. The entire unit is clamped to the aiming post.

Page 27. Paragraph 30*a*(4) is superseded as follows:

(4) Two straps are supplied with each boresight.

Page 28, paragraph 32a. In line 10, change "bridge assembly" to read "bipod."

In line 14, change "remove this cant and re-lay, if necessary." to read "center both level vials and re-lay if necessary."

In lines 14–16, delete last sentence.

Page 30, paragraph 35c. In line 1, change "sight" to read "boresight."

Page 35, paragraph 37c. In line 7, change "M24 tripos" to read "M24 tripod."

Page 38, paragraph 37e(2). In line 4, change "cut" to read "out."

Page 38, paragraph 37e(4). In line 3, add: "Rough level the aiming circle by lengthening or shortening the tripod legs until the bubble in the circular level vial is centered."

Page 46, Table 3. In line 12, under procedures column for the Baseplate assembly M3, add "Remove snap ring, plus three rings and pad under socket. Clean all surfaces. Reassemble." before "Check socket cap to insure free rotation."

Page 46, paragraph 45e. In line 3, add "The cap rests on three rings and a pad, and is held in the baseplate by a snap ring."

Page 48. Paragraph 50*d* is superseded as follows:

d. After each firing mission, and whenever socket does not rotate easily in baseplate (particularly possible in sandy soil), remove the retaining ring by squeezing the tangs together. (Use pliers or other suitable tool. A pair of empty cartridge cases slipped over the tangs can be used.) Remove socket and three rings and one pad below it. Wipe all dirt and grease from rings, pad, socket, and baseplate socket seat. If

rings and pad are rubber and colored brown, coat them with GAA grease. If they are black, replace them with *Combination of Adopted Items* (FSN 1015–247–7177, dwg 11578336) or, if available, with the Rings and Pad Kit which has brass rings. Do not grease the brass rings. Reassemble the cleaned parts and be sure the socket is firmly seated and the retaining ring secured.

Page 49, paragraph 53b. In line 7, add "He also is responsible for keeping the bubbles level during firing."

Page 52, paragraph 60a. In line 8, change "bloackage" to read "blockage."

In line 15, change "is blocked by the barrel when the sight is turned approximately 0700 mils to the right." to read "can be blocked by the cannon as early as 0700 mils to the right, depending on the elevation to be fired."

Page 52. Figure 25 is superseded as follows:

Page 52, paragraph 60b. In line 7, change "black" to read "red."

Page 53. Figure 26 is superseded as follows:

Page 55, paragraph 62c. In line 4, add "far" after "edge of the."

Page 58, paragraph 66a. In line 9, change "setting" to read "setting."

Page 59, paragraph 67a. In line 11, change "foreigh" to read "foreign."

Page 59, paragraph 68b. In line 1, add "the gunner joins the crew and" after "fired,"

In line 2, change "moving" to read "removing."

Page 59, paragraph 68e. In line 3, add "and has the bore swabbed." after "barrel."

Page 61, paragraph 73a(1). In line 1, change "chained" to "chain."

Page 61, Delete paragraph 73*d*.

Page 63, paragraph 75b. In line 2, change "(part 35)" to read "(para 35)."

Page 65. Paragraph 79*a* is superseded as follows:

a. The second ammunition handler retrieves the aiming posts. The gunner removes the sight and puts it in the case as prescribed in paragraph 22*d*(1) or 22*d*(2). Then he lowers the mortar to its minimum elevation.

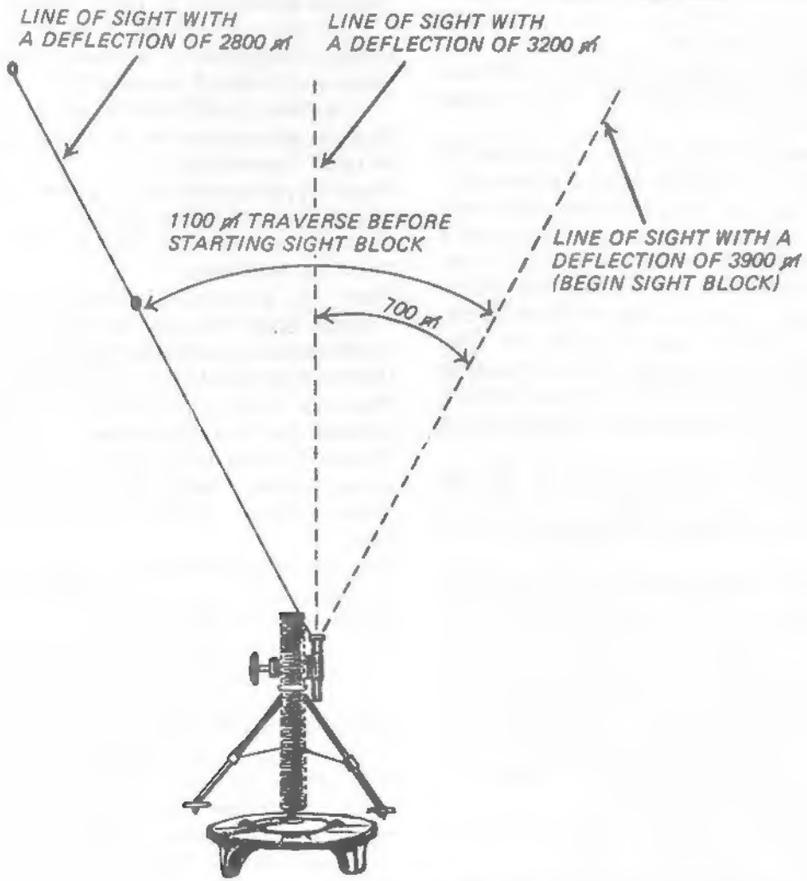


Figure 25. Referring the sight.

Page 65, paragraph 80. In line 3, change "30—35" to read "35—40."

In line 5, change "100" to read "70—80."

Page 65, paragraph 81b(4). In line 2, change "(para 73)" to read "(para 84)."

Page 66. Figure 33 is superseded as follows:

Page 66, paragraph 83b. In line 8, delete "off."

Page 70, paragraph 83g(1). In line 3, delete "approximate."

Page 70, paragraph 83g(3). In line 6, change "posts" to read "direction stakes."

In line 7, add "(fig 30)" after "azimuth."

Page 70, paragraph 84. In line 2, change "construct" to read "construction."

Page 71, paragraph 84d. In line 3, delete "weight zone."

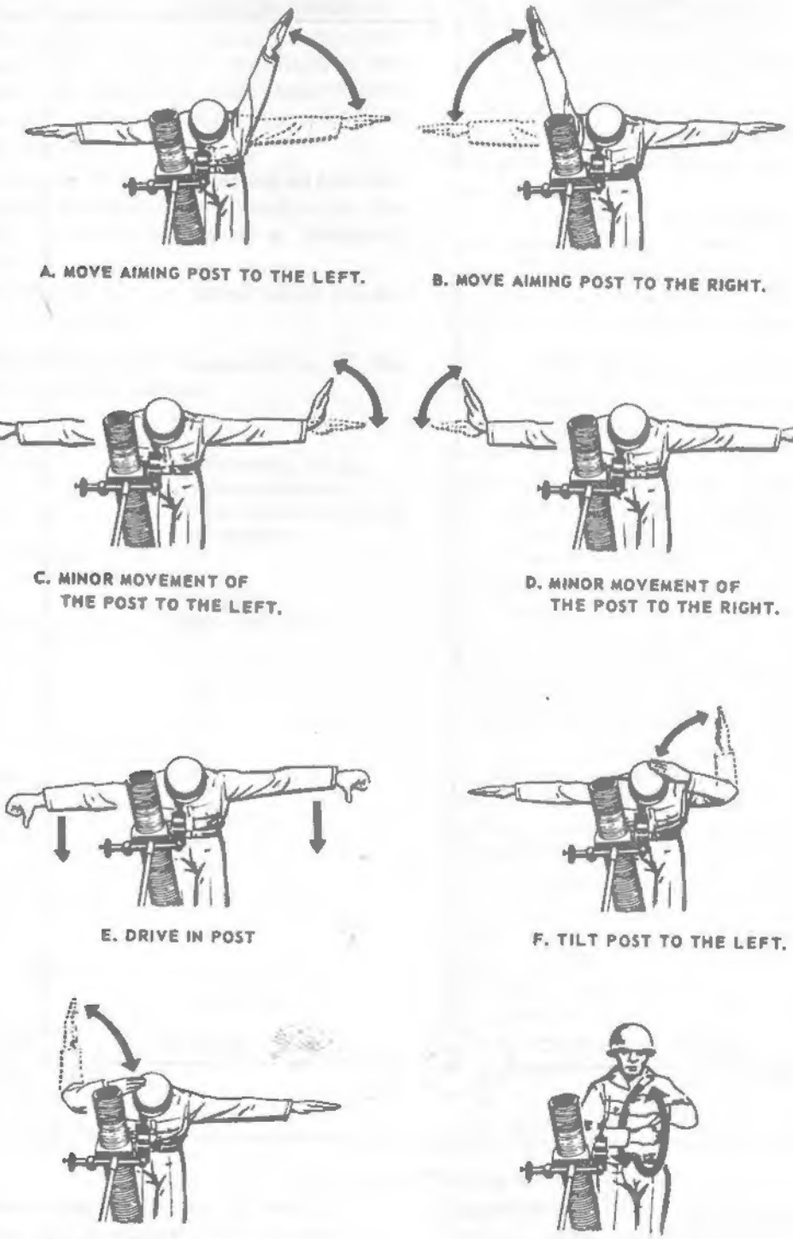


Figure 26. Arm-and-hand signals used in placing out aiming stakes.

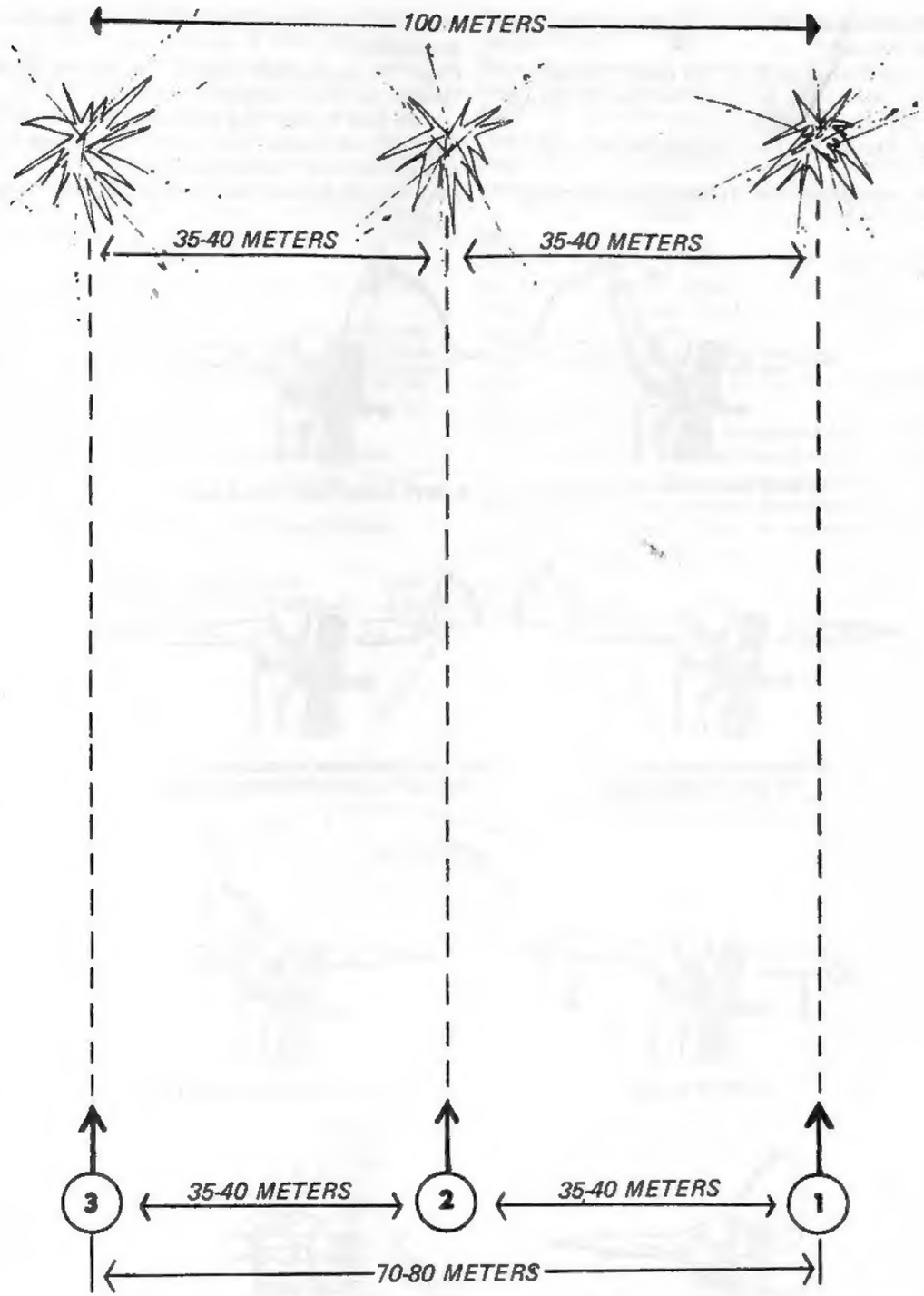


Figure 33. Parallel sheaf.

Page 71, paragraph 85b(1). In line 9, under example column, change "Charge eight and four eights" to read "Charge four."

In line 11, under example column, change "Elevation niner hundred" to read "Elevation one one three four."

Page 71, paragraph 85b(2)(d)2. In line 13, change "NO, 4" to read "NO. 3."

Page 72, paragraph 85b(2)(d)4. In line 3, change "(para 54)" to read "(para 63)."

Page 72, paragraph 85b(2)(g). In line 3, delete "the proximity, MTSQ, and."

Page 73, paragraph 88a. In line 1, change "30–35" to read "35—40."

Page 73. Paragraph 88*c* is superseded as follows:

c. The drill emplacement is used for instructional purposes. The section is mounted in an area conducive to learning and supervision. This may be outdoors or indoors, depending on weather and facilities.

Page 74. Paragraph 88*d* is superseded as follows:

d. The surface emplacement is used to fire the mortar prior to construction of a prepared emplacement.

Page 75. Paragraph 89.1 is added after paragraph 89.

89.1. Characteristics and Capabilities of the M125A1 Mortar Carrier

a. Crew capacity	5
Weight (pounds):	
Combat loaded	24, 527 lbs/11, 125 kg
Air drop	19, 968 lbs/9,057 kg
Armament	81-mm mortar and cal .50 machinegun
b. Mortar capabilities mounted on turntable:	
Traversing	6400 mils
Elevation limits	0700—1500 mils
c. Ammunition stowage (rounds):	
81-mm HE	96
WP/Illum	18
Caliber .50	600
7.62-mm	720
Mortar fuzes	80
d. Measurements:	
Overall length	191½ in/4.8m
Maximum width	106 in/2.7m
Maximum height	86½ in/2.1m
Ground clearance	16⅛ in/40.6 cm
e. Fuel capacity (diesel)	95 gallons/359 liters
f. Performance.	
Speed:	
Land	40 mph/67kph
Water	3 mph/5.6kph
Grade ability:	
Forward slope	60%
Side slope	30%
Vertical obstacle	24 in/61 cm
Trench crossing	5½ ft/1.6m
Turning radius:	
Differential steer	22.7 ft/6.9m
Pivot steer	12.8 ft/3.9m
Cruising range	300 miles/482km

Page 90, paragraph 103f(3)(b). Under 67–69 column, change "0" to read "9."

Page 92, paragraph 103i(3)(b). Under 13—36 column, change "0" to read "9."

Page 93, paragraph 105d. In line 2, change "30 to 35" to read "35 to 40."

Page 93, paragraph 106a. In line 2, change "apart and staggered." to read "apart and may be staggered."

Page 96, paragraph 112. Add paragraph *e* and *f* as follows:

e. Initial range may be determined by:

(1) Estimation by eye.

(2) Map, photo map, or aerial photograph.

f. Methods of alinement:

(1) Direct alinement occurs when the mortar is in defilade and an observer is on the GT line to adjust fire. The squad leader acts as the forward observer.

(2) Direct lay occurs when the gunner can look through the mortar sight and see the target. The gunner is then responsible for bringing effective fire on the target.

Page 96. Paragraph 113 is superseded as follows:

113. Direct Alinement Procedure

This method is the most commonly used in fire without an FDC. In this method the squad leader serves as the forward observer for the squad. To determine the direction in which the mortar is to be laid, the squad leader first picks the location where the mortar will be mounted. The mortar should be in defilade. In alining the mortar on the target the squad leader can use an aiming post, but the best way is to use some sort of aiming stake with a crossarm on it. (Two narrow pieces of wood from an ammunition box nailed together to form a cross will serve as the aiming stake.) To do this the squad leader moves to a point where he can see the target and also see the mortar. He then positions the stake with the crossarm pointed at the target. Without disturbing the stake, he reverses his position so as to sight back along the crosspiece and has the mortar moved to a position alined with the crossarm of the stake. Using this method, the squad leader insures that the mortar, the aiming stake, and the target are all on a straight line (fig 48.1). Once the mortar has been mounted, the gunner insures that a 3200 deflection is placed on the sight and the vertical crosshair is on the squad leader's aiming stake. The mortar is now properly alined and prepared to fire. Once registration or adjustment has been completed, aiming posts can be placed out on a referred deflection as usual. All fire commands and subsequent corrections from the squad leader/forward observer are sent to the gunner and placed directly on the sight.

Page 96. Add figure 48.1 after paragraph 113 as follows:

Page 98, paragraph 117b(1). In line 14, change "quarter" to read "half."

Page 99, paragraph 117b(3). In line 30, change "charge 1" to read "charge 2."

Page 100, paragraph 122. In line 19, change "paragraph 126" to read "paragraph 125."

Page 102, paragraph 128b. In line 5, change "one-quarter" to read "one-half."

Page 102, paragraph 128. Delete paragraph *c.*

Page 103. Paragraph 128*f* is superseded as follows:

f. In figure 52, the observer measures the width of his target to be 100 mils. From a map, he estimates the range to be 1000 meters. Using

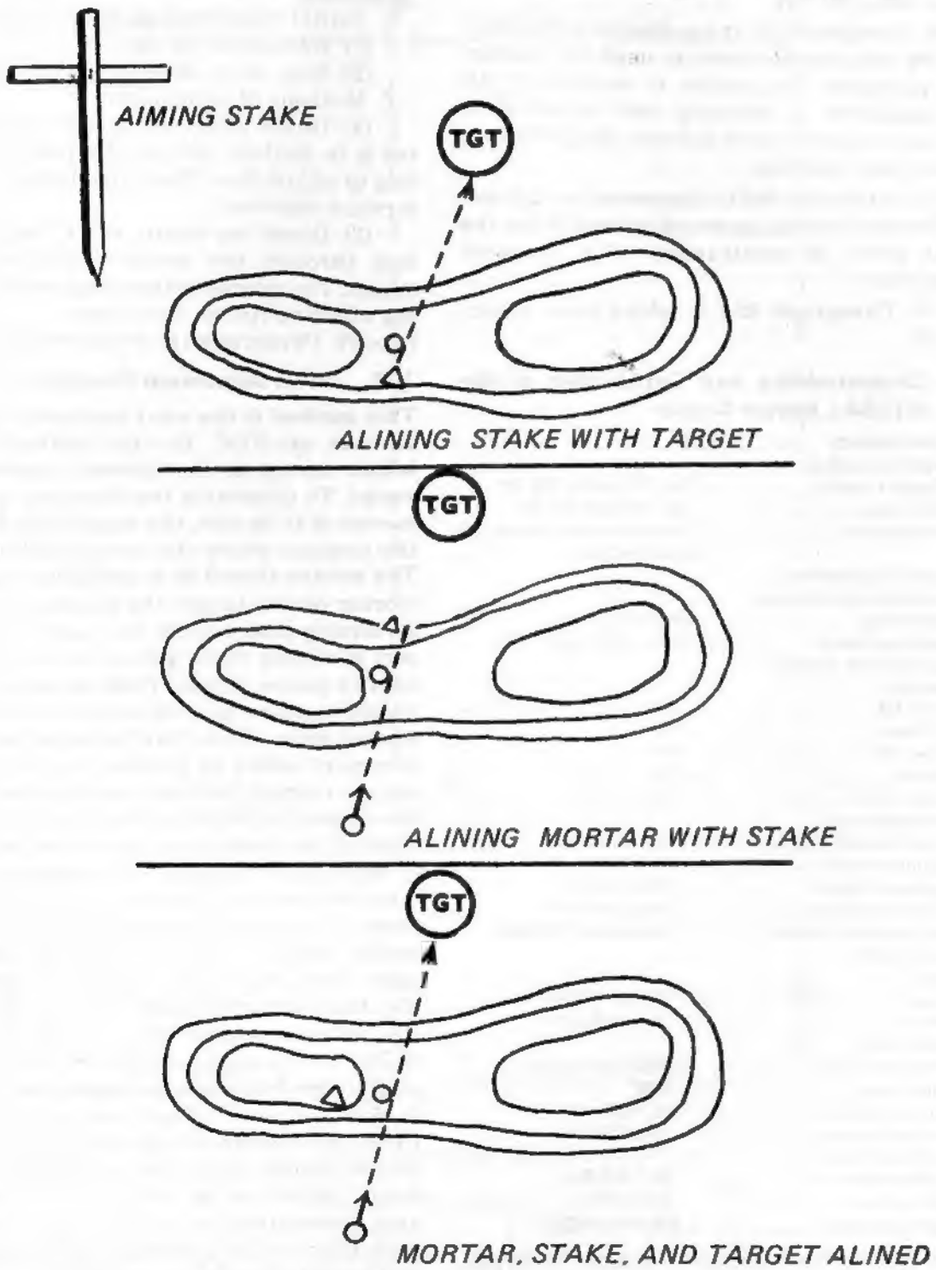


Figure 48.1. Alining the mortar on the target using an aiming stake.

the mil relation formula, he determines the width of the target to be 100 meters. He decides to attack the target with 5 rounds. There will be four intervals between the 5 rounds. As the target is 100 mils wide, he determines the number of turns to be 10 turns. To determine the number of turns between rounds, he divides the number of turns by the number of intervals (10 ÷ by 4 = 2.5 turns). This is rounded off to the nearest one half turn (2½ turns).

Page 103. Figure 52 is superseded as follows:

Page 104, paragraph 129c. In line 5, change "one-quarter" to read "one-half."

Page 104, paragraph 129e. In line 6, change "one-quarter" to read "one-half."

Page 105, paragraph 131a. Delete paragraph (3).

Page 105, paragraph 131c. Change "0" to read "3200."

Page 105, paragraph 132b. In line 3, change "estreme" to read "extreme."

Page 106. Add "FM 23–91, Mortar Gunnery" after FM 23–8.

Page 106. Add "TM 9–1240–287–34, Direct Support and General Support Maintenance Manual: Sight Unit M53" after TM 9–1240–278–12.

Page 107, paragraph 2c(1). In line 6, delete "miniature."

In line 15, delete "miniature."

Page 108, paragraph 2. Add paragraph *f* as follows:

f. Burst Simulator Method of Mortar Training. When other means of training the indirect fire team are not available, the burst simulator method can be used. This method allows the entire mortar section to be trained on its own TOE equipment, indoors or out, without the use of prefabricated training devices.

(1) After a suitable area has been found, a field or gym, the range is set up. Use any convenient scale as long as it is kept constant throughout the range, i.e., 1 foot = 100 meters, 1 meter = 100 meters, 1 pace = 100 meters, etc. Determine where to locate the forward observers. From the FO's position, through the impact area, place range markers at 1000-scale meter increments. These markers must be readable from the FO position. Then place targets in the impact area. Anything can be used from cardboard boxes and tin cans to model train buildings and toy soldiers. The location of the mortar position is then determined and a mounting azimuth through the impact area is calculated. The mortar (or mortars) is mounted, boresighted, and laid, for direction using the aiming circle or M2 compass. After the mortars are laid, place the aiming posts out on a referred deflection (if operating inside, the aiming posts are put in cans of sand or gravel). Another set of range markers are placed out, this time from the mortar position across the impact area. The

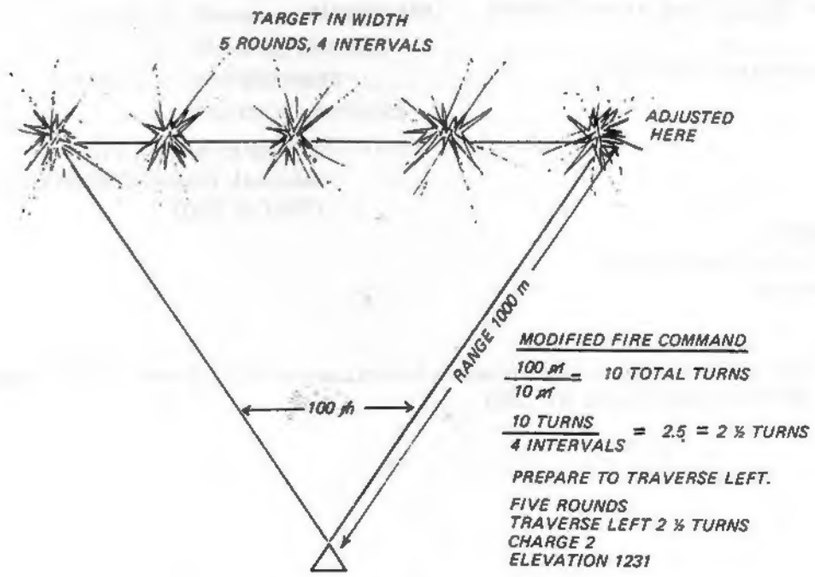


Figure 52. Traversing fire.

mortar range markers should be smaller than the FO range markers and readable only in the vicinity of the marker itself. Locate the FDC in the vicinity of the guns and shield it from sight of the impact area. It can be connected to the FO by radio or wire and to the guns by wire for added realism.

(2) A burst simulator for each mortar is then constructed of cotton, cloth, painted cardboard, or wood with a long wire hook of coat hanger wire. It should be large enough to spot easily but not so large that it obscures targets. For advanced FO training, scale the burst simulator to the bursting area of the round.

(3) Conduct a typical fire mission as follows: The FO will send a call for fire to the FDC requesting a MARK CENTER SECTOR or MARK REGISTRATION POINT. The FDC will use its plotting board and firing tables to determine the proper deflection, charge, and elevation for use with standard "A" ammunition. This firing data will be sent to the guns, where it will be placed on the sight and the mortar alined. The squad leader will then check the alinement and level of the mortar and read off the elevation to the ammunition handler, who will use firing tables to determine what the range for that elevation and announced charge should be. The squad leader will have the assistant ammunition handler move down range with the burst simulator and position himself at that range, guided by the mortar range markers. The gunner will refer the sight to 3200 when using the M53 or 0 with the M34. Using arm-and-hand signals. He will have the assistant ammunition handler move the burst simulator until it is centered on the vertical hairline of the sight. The assistant ammunition handler will place the simulator on the ground and move off the range. The FO observes where the simulator has been placed and either makes a correction or sends in a new call for fire to engage another target. The FO can determine the direction to the target by using his compass, the mil spread by using his binoculars, the range by looking at the FO range markers, and the needed shift by using the mil-relation formula. If the gunner has made a mistake in elevation, it will be reflected in the range to burst as determined by the ammunition handler when reading off the firing tables. If there has been an error in deviation, then the sight is referred back to 0 or 3200 and the burst alined.

(4) After the basic technique has been mastered, there are a few additional touches that can be made to increase the realism. If operating indoors, hills and valleys can be simulated by crumpled newspapers covered by blankets; roads and streams can be simulated by cardboard and engineer tape. The terrain features can be shaped to conform to maps that are on hand, giving the capability to work grid coordinate missions into FO instruction. This technique may be used outdoors. Piles of sand or gravel can be used as terrain features, but if this is not practical, naturally uneven ground can be used and scale maps drawn to conform to the terrain.

By Order of the Secretary of the Army:

FRED C. WEYAND
General, United States Army
Chief of Staff

Official:
VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:
Active Army, ARNG, USAR: To be distributed in accordance with DA Form 12–11A requirements for 81-mm Mortar, M29 (Qty Rqr Block No. 209)

FIELD MANUAL
No. 23–90

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *25 February 1972*

81-MM MORTAR

*This manual supersedes FM 23–90, 30 January 1967, including all changes.

CHAPTER 1

MECHANICAL TRAINING

Section I. INTRODUCTION

1. Purpose

a. This manual provides guidance for the 81-mm mortar squads contained within the mortar platoon. It is concerned primarily with the problems of mortar crew training and drill, and presents practical solutions to these problems that, when applied, will assist in insuring the timely delivery of accurate mortar fires.

b. This manual cannot cover all possible situations. Local situations may dictate minor variations from the methods and techniques described herein. Basic principles should not be violated by modification of techniques and methods.

2. Scope

This manual encompasses all aspects of mortar crew training and drill at the squad and section level. Material presented herein is applicable to conventional or unconventional, nuclear or nonnuclear situations. The scope includes:

a. Nomenclature of the 81-mm mortar.

b. Sighting and fire control equipment.

c. Characteristics and capabilities of 81-mm mortar ammunition.

d. Crew training and drill, ground and mounted.

e. Maintenance.

f. Considerations for tactical employment of the 81-mm mortar section.

3. Comments

Users of this publication are encouraged to submit recommended changes and comments to improve the publication. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons will be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications) and forwarded direct to the Commandant, US Army Infantry School, Fort Benning, Georgia 31905.

4. The Mortar Gunnery Problem

Infantry mortars are normally employed in defilade so that they are not vulnerable to enemy direct fire weapons. For the majority of targets, this prohibits sighting the weapon directly at the target as in the employment of flat trajectory weapons. Because of this, a method known as indirect fire is employed. The gunnery problem is primarily the problem of indirect fire. The solution of this problem requires weapon and ammunition settings which, when applied to the mortars and the ammunition, will cause the round to function on, or at a proper height above, the target. The steps in the solution of the gunnery problem are—

a. Target location.

b. Determination of firing data.

c. Application of firing data to the weapons.

(This manual deals primarily with the application of firing data to the mortars and the conduct of fire of the mortar section.)

5. The Indirect Fire Team

The combined efforts of the indirect fire team are essential for the mortar section to render effective indirect fires for its supported units. The elements of the indirect fire team must be interconnected by an adequate means of communication. The three elements of the team are—

a. Forward Observer Teams. There are three forward observer teams within the mortar section of the weapons platoon. These observer teams detect and report the location of suitable targets, request fire, and conduct adjustments if necessary.

b. The Fire Direction Center. The fire direction center (FDC) determines firing data and furnishes this data in the form of fire commands to the mortar squads.

c. Firing Section. The firing section applies the firing data to the mortars and fires the mortars. There are three mortar squads within the mortar platoon.

6. Principles of Employment of 81-mm Mortar Fires

a. To be effective, the indirect fire team must deliver timely, accurate fires to meet the requirements of supported troops. All members of the indirect fire team must be continuously instilled with a sense of urgency. They must strive at all times to reduce the amount of time required to execute an effective fire mission.

b. For maximum results, mortar fires of suitable density must strike the target at the proper time with the appropriate projectile and fuze.

c. The most effective fires are delivered when observation is good. Limited observation results in a greater expenditure of ammunition and reduces the effectiveness of the fire. Some type of observation is desirable for each target fired upon, to insure that fire is placed on the target. When engaging targets obscured by terrain features and in periods or areas of limited visibility, observation may be made by sound. When visual observation is possible, corrections may be made to place mortar firer on target by adjustment procedures. Lack of observation, however, must not preclude firing on targets that can be located by some other means. For targets that cannot be observed, unobserved procedures must be used to deliver effective fire.

d. In order to inflict a maximum number of casualties, a mass of accurate and timely fire must be delivered. The number of casualties in a specific target area can be increased in most instances by surprise fire. If surprise massed fires cannot be delivered, the time required to bring effective fire on the target should be reduced to a minimum. Emphasis must be placed on speed and accuracy at all levels within the indirect fire team. Inaccurate fire wastes ammunition and greatly reduces the confidence of supported troops in their indirect fire support.

e. The mortar section must be prepared to handle multiple fire missions whenever the situation dictates. The section can be further employed in firing without a fire direction center.

Figure 1. 81-mm mortar, complete.

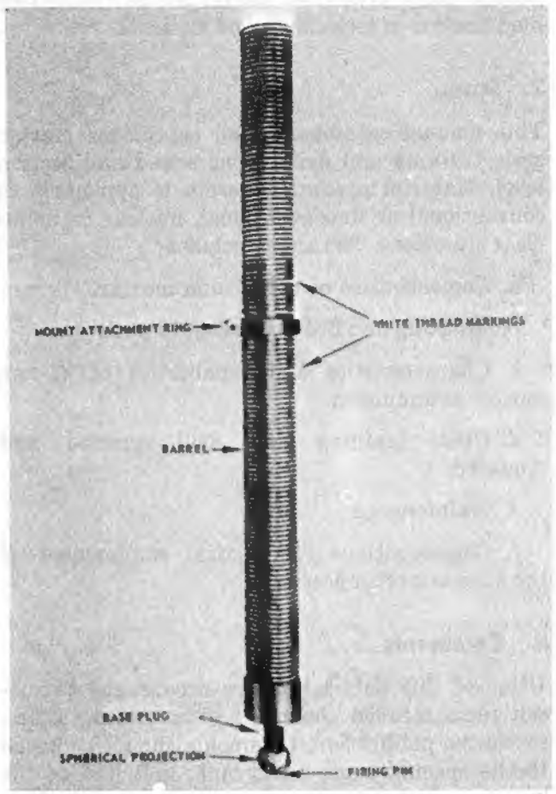


Figure 2. The cannon assembly.

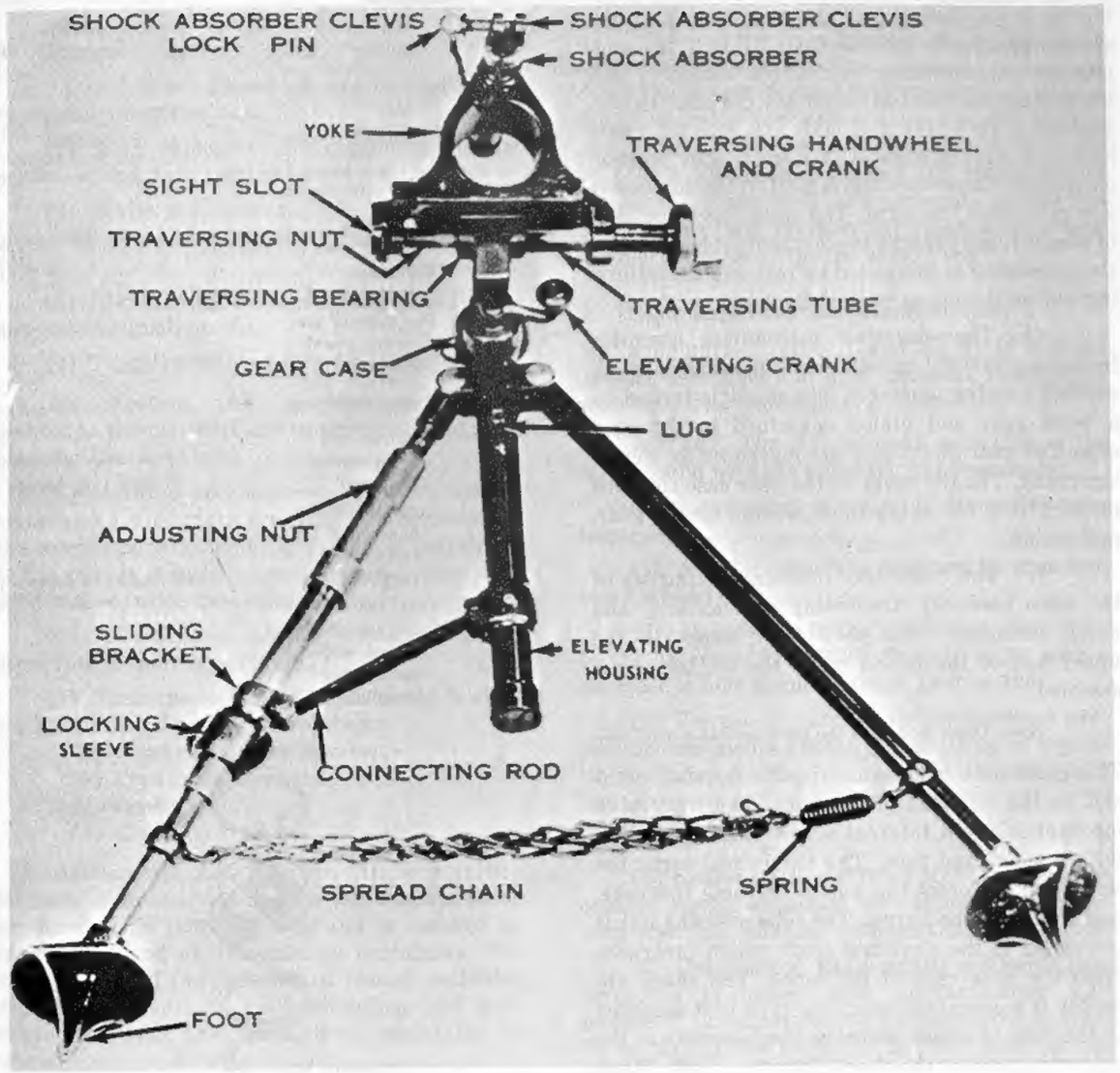


Figure 3. The mount.

7. Description and Nomenclature

a. General Description. The 81-mm mortar is a smooth bore, muzzle-loaded, high angle-of-fire weapon. It consists of a cannon, mount and baseplate.

(1) The cannon consists of the barrel, mount attachment ring, base plug with spherical projection which contains a removable firing pin (fig 2). Throughout this manual the cannon will be referred to as the barrel.

(2) The mount consists of the elevating and the traversing mechanisms (fig 3) and the bipod legs.

(*a*) The bipod legs consist of two tubular steel legs that are hinged at the sides of the elevating mechanisms. The legs have spiked feet and their spread is limited by an adjustable chain. A spring attached to the right end of the chain and the right leg relieves shock to the legs during firing. The right leg has no moving parts. The left leg has a cross-level mechanism consisting of a sliding bracket mounted on the leg with a locking sleeve and an adjusting nut. The

sliding bracket is connected to the elevating housing by a connecting rod. Any movement of the sliding bracket is transmitted through the connecting rod, elevating mechanism assembly and traversing mechanism assembly to the barrel, moving it in a like manner. The locking sleeve locks the sliding bracket in any desired position on the leg. Cross-leveling is performed to remove any cant from the sight. The sight has to be level to attain true readings in elevation and deflection. Cross-leveling is completed by rotating the adjusting nut on the upper part of the leg.

(*b*) The elevating mechanism assembly includes a vertical spindle screw moving in an elevating housing assembly. The screw is turned by a bevel gear and pinion contained in the gear case. The gear and pinion are moved by an elevating crank. The top cover of the gear case contains an oil fitting for oiling the elevating screw, gear, and pinion.

(*c*) The traversing mechanism consists of the yoke assembly, traversing mechanisms, and shock absorber. The yoke body supports the upper end of the barrel when the mortar is assembled.

Note. Older models of the yoke contain a level vial.

The sight unit is mounted in the dovetail sight slot on the left side of the yoke. The traversing mechanism is an internal screw shaft operating within a nut and tube. The handwheel turns the screw which forces the nut to traverse the yoke, and therefore the barrel. The tube over the nut is connected to the elevating shaft which protrudes from the gear case of the bipod. The shock absorber is a compression spring-type unit mounted in the yoke. A shock absorber clevis screws to the projecting end of the shock absorber shaft. When the barrel is assembled to the yoke, this clevis is attached to the barrel ring with the shock absorber clevis lock pin.

(3) The standard baseplate (M3) (fig 4) is of one-piece construction and supports and alines the mortar for firing. During firing, the base plug on the barrel is seated and locked to the rotatable socket in the baseplate, with the barrel passing through the yoke of the mount and secured to the shock absorber by a locking pin.

b. Tabulated Data.

(1) *Weights:*

Barrel	28	pounds
Mount	40	pounds
Baseplate		
M3	25	pounds
M23A1	48	pounds
Sight units:		
M53	5.25	pounds
M34A2	4	pounds

Note. Sight unit M53 is standard A.
Baseplate M3 is standard A.

(2) *Elevation:*

Elevation (approx)	800–1500 mils
Per turn of elevation crank (approx)	10 mils

(3) *Traverse:*

Right or left from center (approx)	95 mils (9½ turns)
Total turns of handwheel for full traverse (approx)	190 mils (19 turns)
Total traverse by movement of mount without moving baseplate	6400 mils

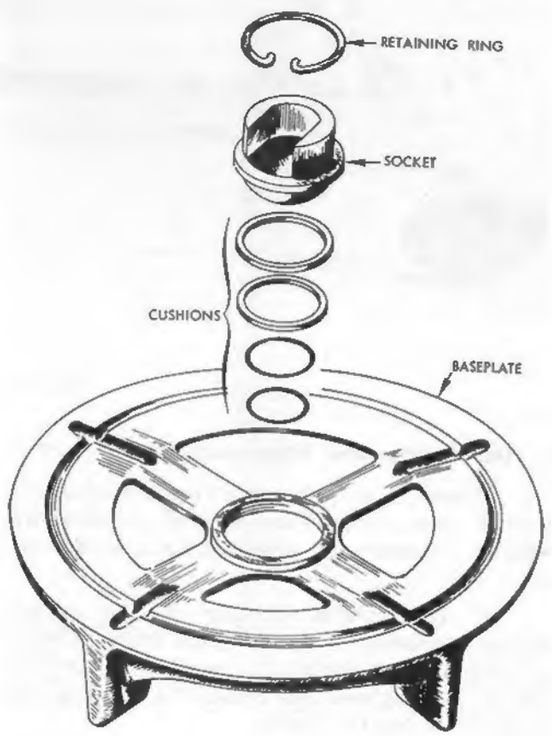


Figure 4. Baseplate, M3.

Section II. AMMUNITION

8. General

a. Classification. Based on use, the principal types of ammunition are:

(1) High explosive (HE) for use against personnel and light materiel.

(2) White phosphorus (WP) for screening, producing casualties, incendiary action, and signaling.

(3) Illuminating (ILL) for battlefield illumination and signaling.

(4) Target practice (TP) for training only.

b. Identification. All mortar rounds are painted to prevent rust and to provide a means of identification as to type.

(1) *Marking on Container.* The contents of ammunition containers are readily determined by the markings. Additional information pertaining to the rounds is included on the ammunition data card packed inside the container.

(2) *Color Scheme.* All projectiles are colored according to their type (table 1).

(3) *Markings on Round.* Each round is stenciled with the following information:

(*a*) Ammunition lot number.
(*b*) Type model of round.
(*c*) Type of filler.
(*d*) Caliber of round.

c. Ammunition Lot Number. An ammunition lot number is assigned to each lot of ammunition produced by a manufacturer and is marked on each round and on the packing containers. The number is used for purposes of record, including reports on condition, malfunctioning, and accidents in which the ammunition might be involved.

d. Authorized Rounds.

(1) High Explosive. M43A1, M43A1B1, M362A1, M362, M374, M374A2.

(2) White Phosphorous. M57A1, M370, M375, M375A2.

(3) Illuminating. M301A1, M301A2, M301A3.

(4) Training Practice. M43A1, M68.

e. Functioning. Each round has fins to stabilize it in flight and cause it to strike and fuze end first. The propelling charge consists of a primer, an ignition cartridge, and removable propellent increments. The primer and ignition cartridge are inserted in the base of the fin shaft. The removable increments are between the fin blades or on the boom assembly. The projectile is dropped down the barrel, fin end first, the primer strikes the fixed firing pin which detonates the primer and ignition cartridge, which in turn ignites the propellent increments, forcing the round out of the barrel. When fired, the projectile carries the fixed primer and ignition cartridge with it and the mortar is ready for the next round.

9. High Explosive Ammunition (HE)

HE ammunition (table 1 and fig 5) is for use against personnel and light materiel, functioning with both fragmentation and blast effect.

a. M374A2. The HE M374A2 cartridge is the M374 round with the following improvements:

(1) A reduction of 0.010″ in diameter to the bourrelet.

(2) A water/moisture resistant ignition system (M66A1).

(3) An increase in the number of flash holes on the fin assembly (M170) from 20 to 24, with a decrease in hole diameter from .196″ to .125″.

(4) The use of water/moisture resistant propellant increments (M90A1) consisting of a plastic laminated coating, reinforced with celcon/silk and sealed on all 3 open ends.

b. M374.

(1) *General.* HE cartridge M374 provides increased range, accuracy, and terminal effectiveness over that obtained with previous HE rounds.

(2) *Description.* The pearlitic malleable iron projectile is loaded with approximately 2.10 pounds of Composition B. The rear of the bourrelet section of the projectile is fitted with an obturator ring with a circumferential groove. The range of the round is increased because of the obturator ring, which is an expanding gas seal ring. The aluminum fin assembly, M149, consisting of an ignition cartridge housing and six extruding fins, is assembled to the rear of the projectile. The fins consist of extruded blades canted counterclockwise 5° at the rear to stabilize the round in flight.

c. M362. The steel forged projectile is loaded with approximately 2.10 pounds of composition B. The aluminum fin assembly, M141, consisting of ignition cartridge housing, fin and increment holders, is assembled to the rear of the projectile.

d. M43A1. The complete round consists of a relatively thin-walled, shallow-cavity steel pro-

Table 1

TYPE & CARTRIDGE	STANDARD CLASSIFICATION	WEIGHT (LBS.)	CHARGE ZONE	MINIMUM RANGE (METERS)	MAXIMUM RANGE (METERS)	COLOR CODE*	BURSTING AREA W /PD FUZE	FUZES	AVERAGE BURNING TIME (SECONDS)	RATE OF DESCENT	AREA OF ILLUMINATION (METERS)	CANDLE-POWER
HE ** M374A2	A	9.34	0 TO 9	72	4737	OD W/ YELLOW MARKINGS	34 METER DIAMETER	M524 M526 M532				
HE M374	B	9.34	0 TO 9	72	4737	OD W/ YELLOW MARKINGS	34 METER DIAMETER	M524 M526 M532				
HE M362		9.42	0 TO 8	50	3550	OD W/ YELLOW MARKINGS	25 BY 20 METERS	M524 M526 M519 M532 M517				
HE M43A1		7.15	0 TO 8 ***	50	3550	OD W/ YELLOW MARKINGS	20 BY 15 METERS	M525				
WP M375A2	A	9.34	0 TO 9	72	4737	LIGHT GREEN W/RED MARKINGS	20 METER DIAMETER	M524 M526 M532				
WP M375	B	9.34	0 TO 9	72	4737	LIGHT GREEN W/RED MARKINGS	20 METER DIAMETER	M524 M526 M532				
WP M370		9.34	0 TO 8	50	3618	LIGHT GREEN W/RED MARKINGS	20 METER DIAMETER	M524 M526 M519				
ILLUM M301A3	A	10.1	2 TO 8	100	3150	WHITE W/BLACK MARKINGS	N/A	M84A1	60	6 METERS PER SECOND	1200	500,000 UNITS
ILLUM M301A2	B	10.71	2 TO 4	100	2150	WHITE W/BLACK MARKINGS	N/A	M84	60	4 METERS PER SECOND	1100	500,000 UNITS
ILLUM M301A1		10.71	2 TO 4	100	2150	WHITE W/BLACK MARKINGS	N/A	M84	60	4 METERS PER SECOND	1100	500,000 UNITS
TP M43A1		7.15	0 TO 8 ***	50	3550	BLUE W/ WHITE MARKINGS	N/A	N/A				
M68		10.7	N/A	50	300	BLACK W/ WHITE MARKINGS	N/A	N/A				

NOTES * COLORS INDICATED ARE NEW NATO COLOR CODE. OLD U. S. COLOR CODE: HE - OD WITH YELLOW MARKINGS; WP - GREY WITH YELLOW MARKING; ILL - GREY WITH WHITE MARKING.

** THE M374 AND M375, AND THE M362 AND M370 ARE TWO FAMILIES OF AMMUNITION. THE "FAMILY" CONCEPT AFFORDS SEVERAL ROUNDS WITH A VARIETY OF FUZE ACTIONS AND FILLER CAPABILITIES ALL USING THE SAME FIRING TABLE, DUE TO IDENTICAL BALLISTIC CHARACTERISTICS.

*** THE M43A1 TP ROUND COMES PACKAGED WITH SIX CHARGE INCREMENTS BUT AN ADDITIONAL TWO MAY BE ADDED.

jectile containing a TNT bursting charge, PD fuze, fin assembly, with propellent charges.

10. White Phosphorus Ammunition (WP)

White phosphorus ammunition (table 1 and fig 5) is used for screening, producing casualties, incendiary action, and signaling.

a. M375A2. The HE M375A2 cartridge is the M375 round with the following improvements:

(1) A reduction of 0.010″ in diameter to the bourrelet.

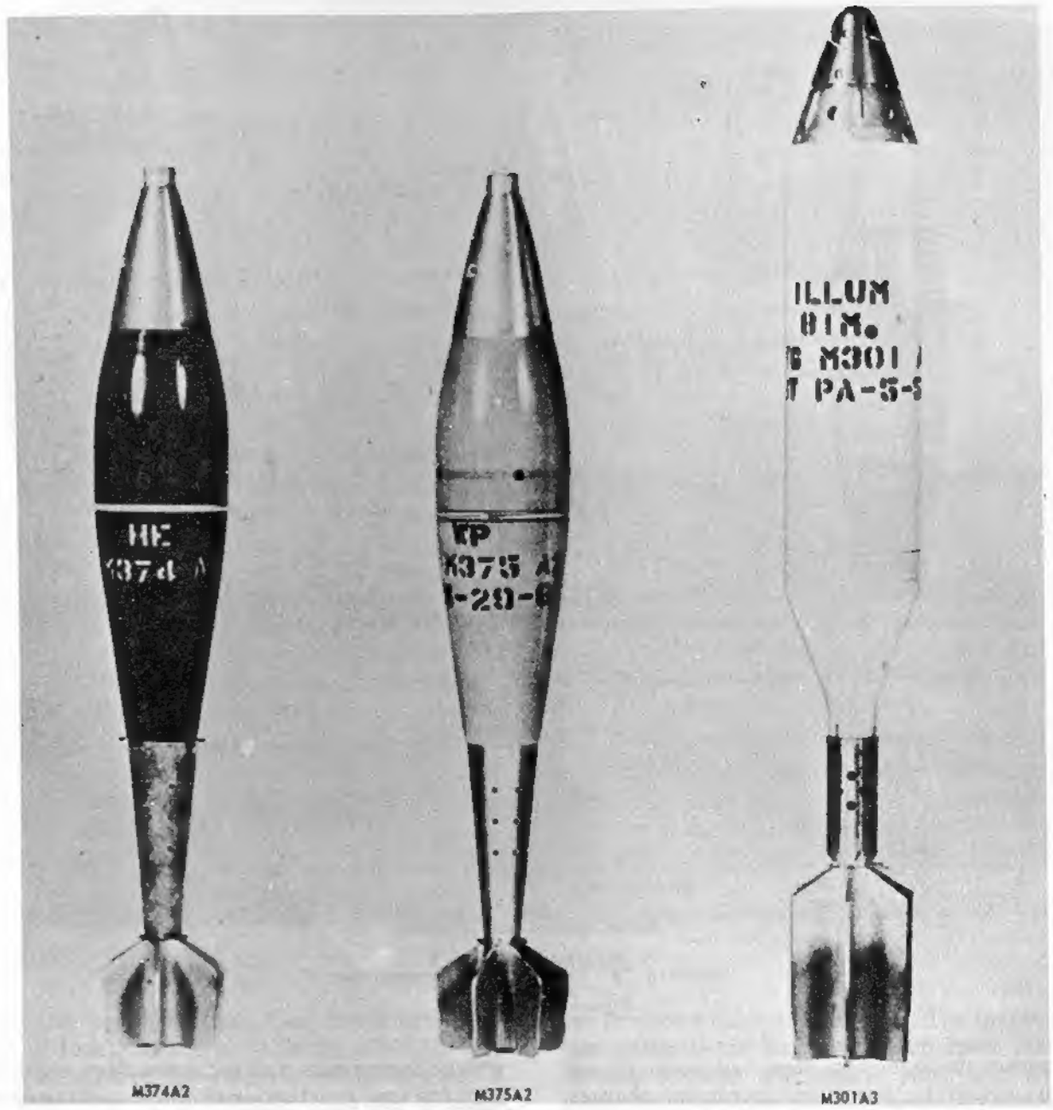
(2) A water/moisture resistant ignition system (M66A1).

(3) An increase in the number of flash holes on the fin assembly (M170) from 20 to 24, with a decrease in hole diameter from .196″ to .125″.

(4) The use of water/moisture resistant propellant increments (M90A1) consisting of a plastic laminated coating, reinforced with celcon/silk and sealed on all 3 open ends.

b. M375.

(1) *General.* The M375 WP round is ballistically identical to the 374 HE round (9*b* above) except for the white phosphorus filler.



Standard "A" 81-mm mortar ammunition

Figure 5.

(2) *Description.* This cartridge is similar to HE cartridge M374 except that the projectile is loaded with approximately 1.6 pounds of white phosphorus, and contains a one-piece aluminum burster casing (M158) prefilled to the forward end of the body. The burster casing houses a central burster tube containing RDX.

c. M370. The M370 WP round is ballistically identical to the M362 HE round (9*c* above) except for the white phosphorus filler.

11. Illuminating Ammunition (ILL)

Illuminating ammunition (table 1 and fig 5) is used for battlefield illumination and signaling.

a. M301A3.

(1) *Description.* The complete round consists of a time fuze, thin-walled steel body-tube assem-

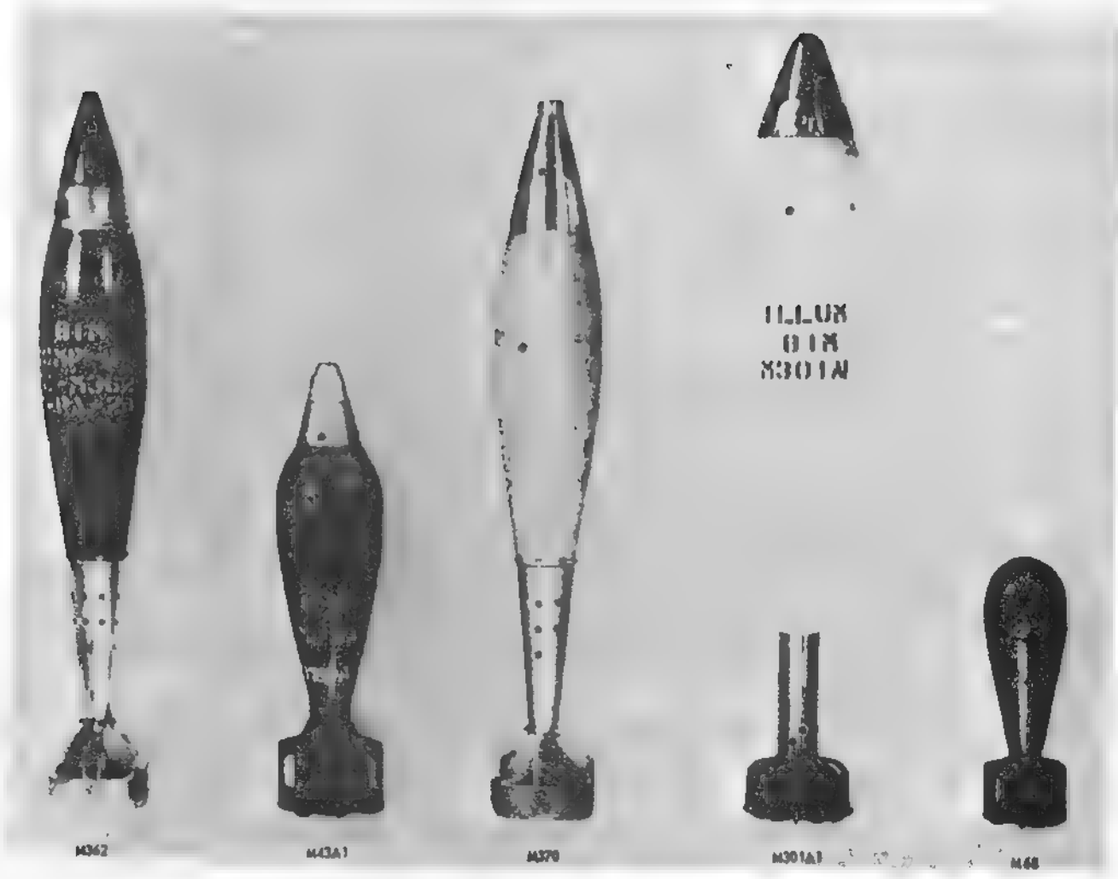
Standard "B" 81-mm mortar ammunition

Figure 5.—Continued.

bly, parachute assembly, steel tail cone, fin assembly containing propellent increment charges, ignition cartridge, and percussion primer. A steel fuze adapter is assembled to the front end of the body. A tail cone is inserted into the body-tube and is held in position by four equally spaced shear pins. The base of the cone is fitted with an internally threaded adapter for attachment of the fin assembly. The illuminant assembly consists of a first-fire charge and an illuminant contained in a boxboard case. A quick-match assembly is posted at the forward end of the boxboard case. The parachute assembly is attached to the illuminant assembly casing by a 30-inch-long steel suspension wire.

(2) *Functioning.* This cartridge is designed to be fired with a minimum of two propelling charge increments and not more than eight. Except for this, functioning of the propelling charge increment is the same as for other 81-mm mortar rounds. Upon functioning of the fuze, the fuze expelling charge ejects the parachute and illuminant assemblies through the base of the projectile, at the same time igniting the quick match. The quick match ignites the first-fire charge which lights the illuminant composition. The round has a height of burst of 600 meters and will illuminate a 1200-meter area for a minimum of 60 seconds.

b. M301A2. Illuminating cartridge M301A2 is similar to the M301A3 with the exception of a smaller tail fin that is 2.27 inches shorter than the M301A3. The round is designed to be fired with a minimum of two propelling charge increments and not more than four increments. The M301A2 functions the same as the M301A3. The height of burst of this round is 400 meters and it will illuminate an 1100-meter area for a minimum of 60 seconds.



Other 81-mm mortar rounds

Figure 5.—Continued.

c. M301A1. Illuminating cartridge M301A1 is similar to the M301A2 except that it has gas check bourrelet grooves and some minor dimensional differences in metal parts. The height of burst and the size of the area illuminated are identical to the M301A2 round.

Note. For further information on ammunition see TM 9–1300–203.

12. Target Practice Ammunition (TP)

a. M43A1. Target practice cartridge M43A1 (table 1) is intended for use in training only, and is similar to the M43A1 HE (para 9*d*) except for the projectile filler and its color. The target practice projectile is loaded with an inert material (plaster-of-paris and stearic acid) and a 0.05-pound black powder pellet. The black powder pellet is loaded at the forward end of the projectile cavity adjacent to the rear end of the booster casing of the fuze. On impact, the black powder pellet and fuze booster charge provide a spotting charge for observation purposes. The projectile is loaded to simulate the weight of the high explosive projectile and has the same ballistic characteristics.

b. M68. Training cartridge M68 is provided for training in loading and firing 81-mm mortars. The projectile is completely inert and has no fuze. It consists of a cast-iron, pear-shaped body which is drilled at the narrow base for assembly of fin assembly M6. No propellent increment charges are issued or used except ignition car-

tridge M3 and percussion primer M34 with ignition cartridge M6. All components are issued separately to facilitate replacement of worn-out parts and expended ignition cartridges.

13. Fuzes

a. Point Detonating Fuzes (PDF).

(1) *M524 Series.* Dual purpose fuze M524A5 (fig 6), superquick or 0.05 second delay, is used with M362 series HE cartridges and M374 or with WP cartridges M370 and M375. The fuze is designed for superquick impact action with greater sensitivity and speed than fuzes formerly used with 81-mm mortar ammunition and functions on point impact or graze contact. The fuze contains a delayed arming feature which assures that the fuze will remain unarmed and detonator-safe for a minimum of 1.25 seconds of flight from the muzzle of the mortar, but will arm within a maximum of 2.50 seconds from the muzzle. To prepare for firing—turn the slot in the striker (at the nose of the fuze) to aline with the SQ index or the D index on the fuze body, depending upon which action of the fuze is desired. *Remove the safety pull wire just prior to insertion of the round into the mortar.*

Note. If, upon removal of the pull wire, a buzzing sound in the fuze is heard, the cartridge should not be used. Such a cartridge is still safe to handle and transport provided the safety wire is reinserted.

***WARNING:* If the plunger safety pin (upper pin) cannot be reinserted, the fuze may be armed. An armed fuze must not be fired since it will be premature. It should be handled with extreme care and EOD personnel notified immediately. Depression of striker (fuze point) or any movement of cartridge which would cause the plunger to move forward against the creep spring may cause the detonator to move forward against the firing pin, resulting in detonation of the cartridge. If handling of a cartridge with a suspected armed fuze is absolutely necessary, the cartridge must be held vertically with the fuze striker assembly up.**

(2) *M525, M525A1.* These fuzes are modifications of M52 series fuzes. The modification consists of the substitution of a head assembly containing a delayed arming device in addition to the firing pin mechanism. These fuzes are used for the M43 HE and TP series ammunition.

(3) *M526 series.* These fuzes, which are replacing PD fuze M519, consist of the former M52 series fuzes modified, as in the M525 series, with an arming delay and, in addition, fitted with an adapter containing booster pellets to adapt to a

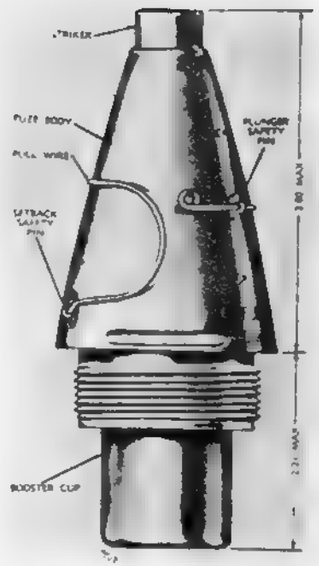


Figure 6. Fuze, point detonating: M524A5.

newer design ammunition. This fuze may be used instead of PD fuze M524A1 in cartridges M362 and M374 HE and M370 and M375 WP.

(4) PD fuze M519, which is a combination of PD fuze M525A1 and a fuze adapter, is a single action type with a direct action firing device for use with cartridges M362 HE and M370 WP. The propelling charge consists of a primer, an ignition cartridge, and eight wax-treated cotton cloth bag increments assembled to the base of the round as issued. Each increment bag has a button hole on each end. The bags are attached to the projectile by engaging the button holes over the kidney-shaped projections of the increment holes. These rounds will be fired only at charges 2 through 8.

b. Proximity Fuzes (VT).

(1) *Disposal precautions.* Proximity-fuzed short rounds which are duds contain a complete explosive train and impact element and should not be approached for 5 minutes or disturbed for at least 30 minutes after firing. After the 30 minute waiting period, the dud is still dangerous but may be approached and removed carefully or destroyed in place by qualified disposal personnel. If the situation permits a longer waiting period, the dud may be considered safe for handling after 40 hours.

(*a*) *Burst height.* The principal factors affecting height of burst are the angle of approach to the target and the reflectivity of the target terrain. The airburst over average types of soil range from 1 to 6 meters, depending on the angle of approach. High angles of approach (near vertical) give the lowest burst heights. Light tree foliage and light vegetation affect the height of burst only slightly, but dense tree foliage and vegetation will increase the height of burst. Target terrain such as ice and dry sand give lowest height of burst whereas water and wet ground give highest burst heights.

(*b*) *Crest clearance.* Close approach to crests, trees, towers, large buildings, parked aircraft, mechanized equipment, and similar irregularities will cause functioning at heights greater than average level. When targets are beyond such irregularities, a clearance of at least 30 meters should be allowed to assure maximum effect over the target area.

(*c*) *Climatic effects.* The fuzes may be used for day or night operations. They function normally in light rain. However, heavy rain, sleet, or snow may cause an increase in the number of early bursts. At extreme temperature (below −40° F and above +125° F) it is not abnormal to experience an increase in malfunctions proportionate to the severity of conditions.

(*d*) *Preparations for firing.* Insert the fuze (with wavy washer in position) into the fuze cavity of the projectile and screw the fuze in manually by grasping the metal portion (base) of the fuze. Use the M18 wrench to tighten the fuze to the projectile so that no clearance exists between the fuze and the body of the projectile.

(2) *Care, handling, and preservation.* Proximity fuzes will withstand normal handling without danger of detonation or damage when in their original packing containers or when assembled to projectiles in their packing containers.

***WARNING:* Explosive ammunition or components must be handled with appropriate care at all times. The explosive elements in primers and fuzes are particularly sensitive to undue shock and high temperature. Boxes containing ammunition should not be dropped, thrown, tumbled, or dragged.**

(3) *M532* (fig 7).

(*a*) *General.* The M532 is a radio-doppler fuze which is standard for the M374 HE round and may also be used on the M362 HE or the M375 WP round. It provides an airburst at or near a height for optimum effectiveness by employment of the radio doppler principle of target detection. A clock mechanism provides a nominal 9 seconds of safe air travel (610 to 2340 meters travel along trajectory for charge 0 through 9, respectively). It can also be set superquick (point detonating) to eliminate the proximity function.

(*b*) *Functioning.* Once set to act as a point detonating fuze, the M532 cannot be reset to react as a proximity fuze. The fuze will arm and function normally when fired at any angle of elevation between 0800 and 1406 mils and at charge 1 through 9. The fuze was not intended to function at charge 0; however, at temperatures above 32° F and at angles of fire of 1068 mils and above, the flight time is sufficient to permit arming. Firing at charge 0 does not affect safety because if insufficient flight time (11 seconds minimum) is achieved, the fuze will be a dud.

(*c*) *Converting to PDSQ.* The proximity fuze can be converted to a point detonating fuze action by rotating the top of the fuze more than 120° (1/3 turn) in either direction. This action accomplishes two things: First, it breaks the shear-pin located between the PD mark on the side of the fuze, and secondly, it breaks an internal wire which disables the proximity action and converts the fuze to PDSQ.

(4) *M517.*

(*a*) *Operation.* This proximity fuze is provided for use with the M362 high-explosive round. It will not function in the M374 or M375 rounds because of the spin. The M517 fuze's operating principles are similar to the M532. It differs primarily from the M532 in the arming system. The minimum time (after firing) to arm for an impact function is in excess of 1.5 seconds. The minimum time (after firing) to arm for proximity function is 3.2 seconds. This fuze does not provide a PDSQ option.

(*b*) *Malfunctions.* Malfunctions may be divided into early bursts (a spontaneous functioning of an armed proximity fuze at some time after arming has been completed but prior to proximity approach to the target) and duds (complete failure to fire). It should be noted that early bursts are not related to premature firing (a detonation of the fuze projectile before the fuze is completely armed).

c. Mechanical Time Fuze, M84 (fig 8).

(1) *General.* This fuze is a single-purpose, powder train, selective-time type used with the 81-mm illuminating cartridge M301A1 and M301A2. It has a time setting of up to 25 seconds.

(2) *Description.* The fuze consists of a brass head, a body assembly, and expelling charge. The fuze body is graduated from 0 to 25 seconds in 1-second intervals; 5-second intervals are indicated

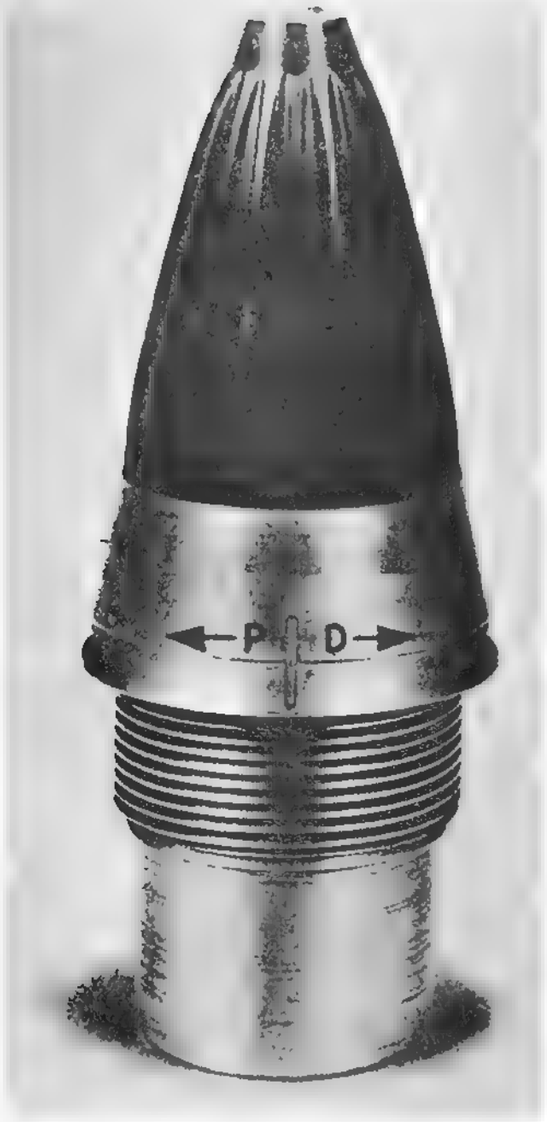


Figure 7. Fuze, proximity: mortar M532.

by bosses. The 0-second boss is wider and differs in shape from the other body bosses; the safe setting position is indicated by the letter S on the fuze body. The adjustment ring has six raised ribs for use in conjunction with fuze setter, M25, and a setting indicator rib (marked SET) approximately half the height and width of the other six ribs. Safety prior to firing is provided by a safety wire which must be removed just prior to firing.

d. Mechanical Time Fuze M84A1.

(1) *General.* This fuze is a single-purpose, tungsten ring, selective time type used with the 81-mm illumination cartridge M301A3. It has a time setting of up to 50 seconds.

(2) *Description.* The fuze consists of a brass head, a body assembly, and expelling charge. The fuze body is graduated from 0 to 50 seconds in 2-second intervals; 10 second intervals are indicated by bosses. The 0-second boss in wider and differs in shape from the other body bosses; the safe setting position is indicated by the letter S on the fuze body. The adjustment ring has six raised ribs for use in conjunction with fuze setter, M25, and a setting indicator rib (marked SET) approximately half the height and width of the other six ribs. Safety prior to firing is provided by a safety wire which must be removed just prior to firing.

14. Fuze Setters

a. The M25 fuze setter is used to set the time fuze M84 and M84A1 on the illuminating round. This fuze setter is a flat-handled wrench and has no time scales. It has a circular hole at one end into which notches are cut to fit over the raised ribs on the movable adjustment ring. Place the fuze setter over the fuze so that the notches in the circular hole engage the ribs on the movable adjustment ring. Rotate in a counterclockwise direction and index the desired time setting. If the time setting has been passed, *do not* turn the fuze back. Continue turning the fuze in the counterclockwise direction to set the exact time setting.

Note. If a fire mission is cancelled and the fuzes have a time setting already placed on them, continue turning in the counterclockwise direction to the safe position.

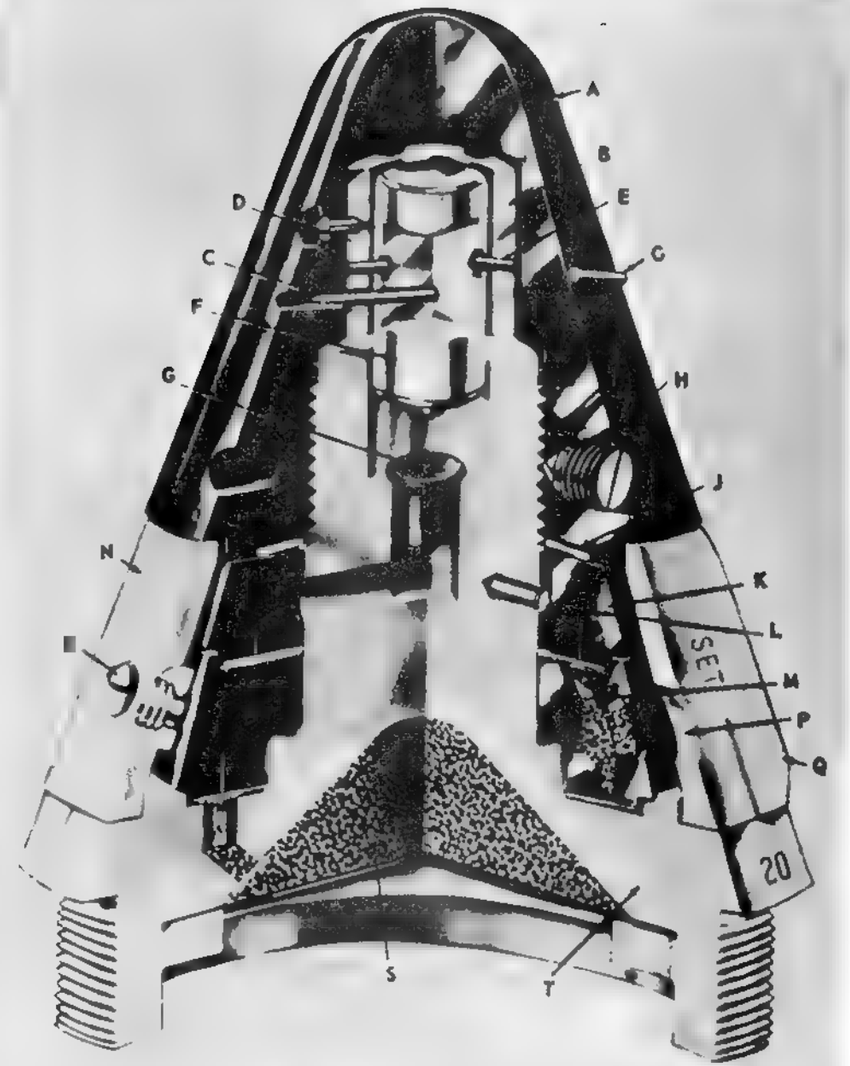
b. Fuze wrench M18 is a box-type wrench having two throat openings; the proximity end opening is 2.16 inches and the opening at the other end 2.04 inches. This wrench is used with the M517 proximity fuze and closing plugs for 81-mm mortar rounds.

c. A regular pipe wrench may be used in the same manner as stated above. Care must be taken to insure that the wrench is not too tight, causing damage to the fuze.

d. The strap wrench for holding the projectile during removal of the fuze with the fuze wrench M18 is illustrated in figure 9.

15. Propelling Charges

a. General. The propelling charges (except for the training shell) consist of a primer, an ignition cartridge, and bundles of powder called increments. Short and varied ranges resuit if these increments become wet; therefore, protect them



A – HEAD
B – PLUNGER GUIDE
C – SAFETY WIRE
D – POSITIONING PIN
E – SHEAR PIN
F – PLUNGER
G – PERCUSSION PRIMER
H – SET SCREW
J – WASHER
K – UPPER TIME–TRAIN RING
L – LOCK PIN
M – LOWER TIME–TRAIN RING
N – ADJUSTMENT RING
P – VENT HOLE
Q – RIB
R – LOCK SCREW
S – EXPELLING CHARGE
T – BODY ASSEMBLY

Figure 8. Fuze, time: M84.

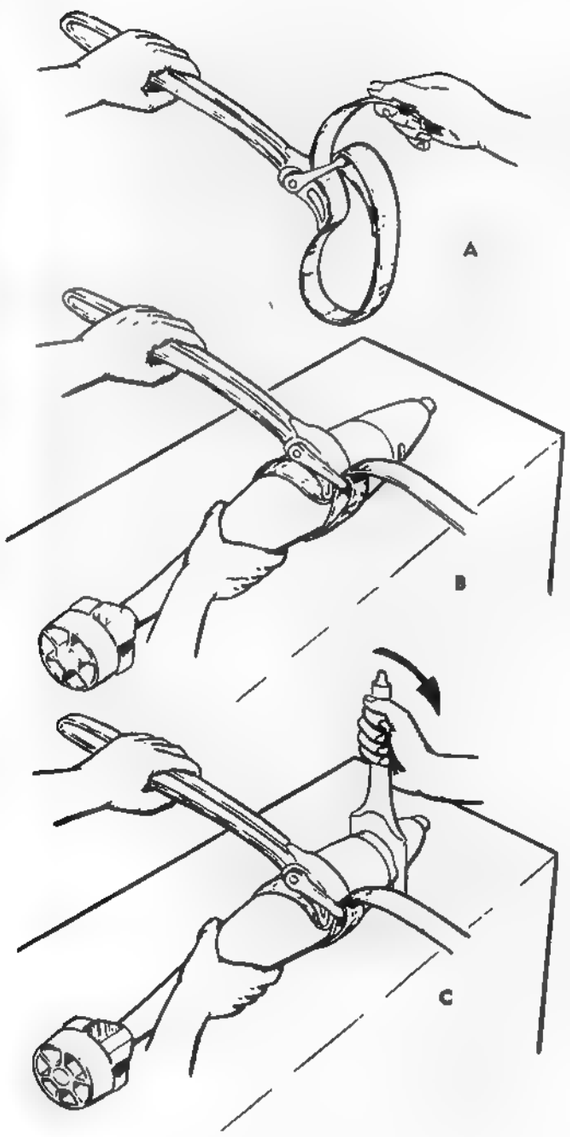


Figure 9. Removing fuze.

from rain and moisture. With most 81-mm mortar ammunition the primer is separate from the ignition cartridge. The ignition cartridge issued for use with the shell contains the primer.

b. M374 and M375 Rounds. The propelling charge consists of a primer, an ignition cartridge, and nine wax-treated cotton cloth bag increments assembled to the base of the round as issued. Each increment bag has a buttonhole on each end. The bags are attached to the projectile by engaging the buttonholes over the kidney-shaped projections of the increment holes. When firing these rounds at charge 1 *use only the yellow spiral base charge.* Charges 2 thru 9 are white.

c. M362 and M370 Rounds. The propelling charge consists of a primer, an ignition cartridge, and eight wax-treated cotton cloth bag increments assembled to the base of the round as issued. They are attached to the round as are the charges on the M374 and M375 rounds.

d. M301A1 and M301A2 Rounds. The propelling charge consists of primer, an ignition cartridge, and four rectangular propellent increments assembled to the base of the round. The increments are held against the forward edge of the fin by a propellent holder and are covered with individual waterproof bags which are not removed.

e. M301A3. The propelling charge consists of a primer, an ignition cartridge and six square propellent increments assembled to the base of the round as issued. One increment is fitted into each of the spaces between the blades of the fin and held by a propellent holder. Increments for these rounds are covered with individual waterproof holder. Increments for these rounds are covered with individual waterproof cellophane bags which are not removed from the increments.

f. M68 Training Shell. An ignition cartridge is the only propelling charge used for this projectile. The ignition cartridge is a shotgun-shell type cartridge which contains the primer.

g. Burn Unused Increments. Because of their high combustibility, be careful when igniting them. Do not allow excess increments to accumulate near the mortar positions. Remove to a designated place of burning and destroy as follows: Select a place at least 100 meters from the mortar position, parked vehicles, and ammunition piles. Preburn all dead grass or brush within 30 meters or more around the burning place. Do not burn increments in piles but spread them in a train 1 to 2 inches deep, 4 to 6 inches wide, and as long as necessary. From this train, extend a starting train of single increments laid end to end. End this starting train with not less than 1 meter of inert material (dry grass, leaves, or newspapers). Ignite the inert material. (Many US Army posts have a special SOP for disposal of unused increments. Check post SOP before applying above procedure.) Do not leave unused increments unburned in combat operational areas. The enemy will use them. *Burn all unused increments.*

16. Firing Tables

Firing tables are provided for each type of round. Abridged tables are printed in card form and are included in each ammunition packing box.

17. Care, Handling, Preservation, and Storage of Ammunition

Ammunition is made and packed to withstand all conditions ordinarily encountered in the field. However, since explosives are adversely affected by moisture and high temperature, due consideration must be given to their protection under such conditions.

a. Before-Firing Checks.

(1) Ammunition should be free of rust and dirt.

(2) Check fin and fuze assembly for tightness and/or damage.

(3) Insure charges are dry.

(4) Remove any extra increments if the round is to be fired with less than full charge.

(5) With the exception of a few unused increments (within the same ammunition lot number) as replacements for defective increments, excess powder should be removed from the mortar position.

(6) Check primer cartridge for damage or dampness.

b. Complete rounds, being fuzed, are handled with care at all times. The explosive elements in primers and fuzes are particularly sensitive to strong shock and high temperature.

c. Do not break the moisture-resistant seal of the container until the ammunition is to be used. When a large number of rounds are required for a mission, they may be removed from the containers and prepared. Propelling charges are covered or protected from dampness or heat.

d. Do not attempt to disassemble any fuze.

e. Protect the ammunition from mud, sand, dirt, and water. The round should be free of such foreign matter before firing. If it gets wet or dirty, wipe it off at once.

f. Do not allow the ammunition, particularly the powder increments, to be exposed to direct sunlight for any length of time. More uniform firing is obtained if the rounds are kept at the same temperature.

g. Remove the pull wire and safety wire from the fuze *just before firing.* When rounds have been prepared for firing, but are not used, *replace all powder increments and safety wires* which have been removed, and return the rounds to their original containers. Use these rounds first in subsequent firing so that once-opened stocks may be kept at a minimum.

h. DO NOT HANDLE DUDS!

i. Storage.

(1) Whenever practicable, store amunition under cover. Should it be necessary to leave the ammunition in the open, raise it on dunnage at least 6 inches from the ground and cover the pile with a double thickness of tarpaulin. Dig suitable trenches to prevent water from flowing under the pile.

(2) In arctic weather, store ammunition in its original box or create. Place it on pallets and cover with double thickness of tarpaulin.

(3) Store white phosphorus rounds with the fuze end up. Since white phosphorus liquifies at about 100° F., protect the ammunition against an uneven rehardening of the filler. An air cavity formed on one side of the shell will unbalance it and cause instability in flight.

j. REMEMBER, *ALWAYS* CHECK AMMUNITION BEFORE IT IS NEEDED.

18. Rates of Fire

Cartridge	*Mortar*	*Maximum rounds per minute*	*Sustained rounds per minute*
M362	M29	15 for 2 min 27 for 1 min	4
M362	M29E1	25 for 2 min 30 for 1 min	5
M374 and M375	M29	18 for 2 min 30 for 1 min	5
M374 and M375	M29E1	25 for 2 min 30 for 1 min	8

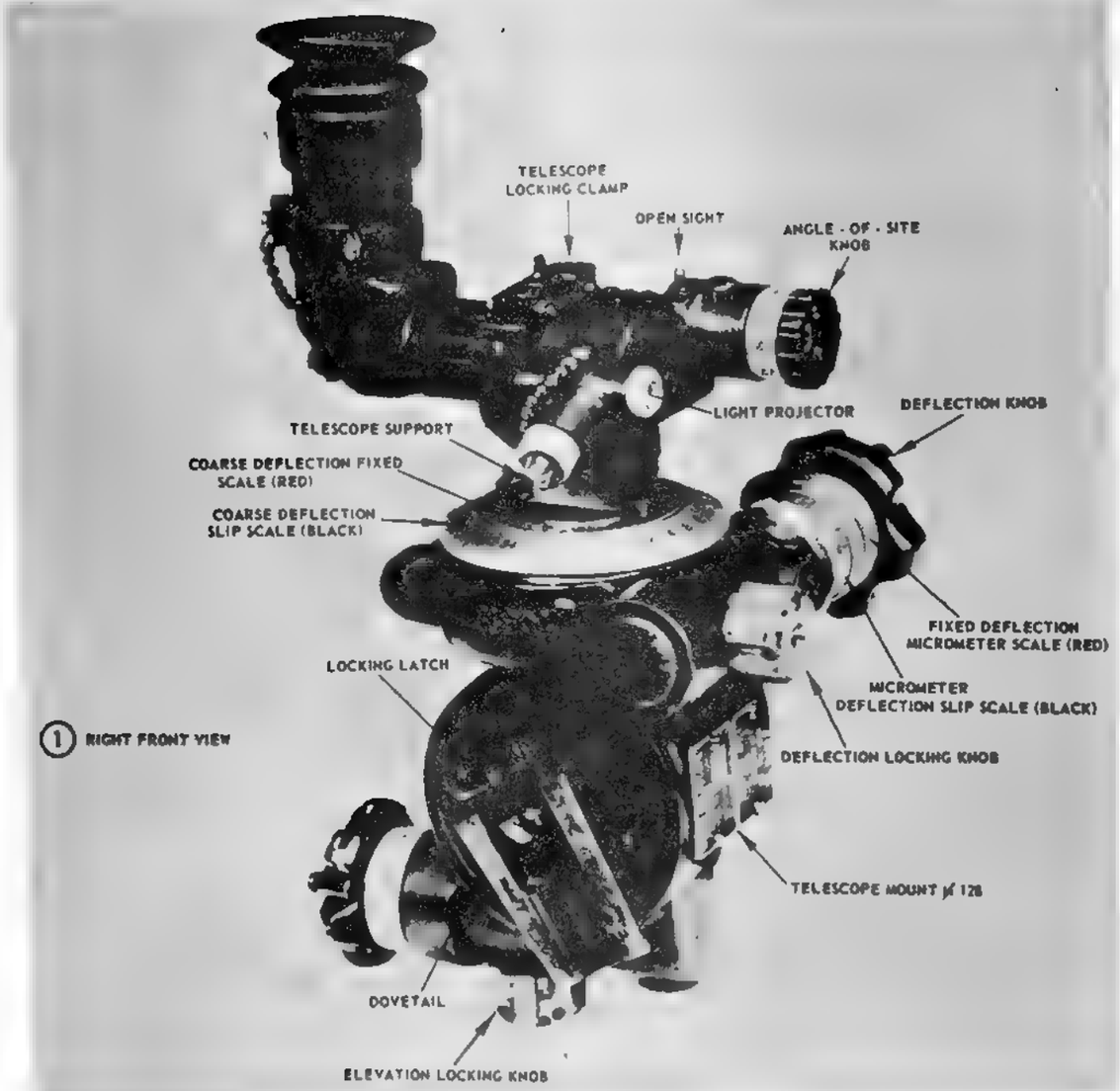


Figure 10. M53 sight unit.

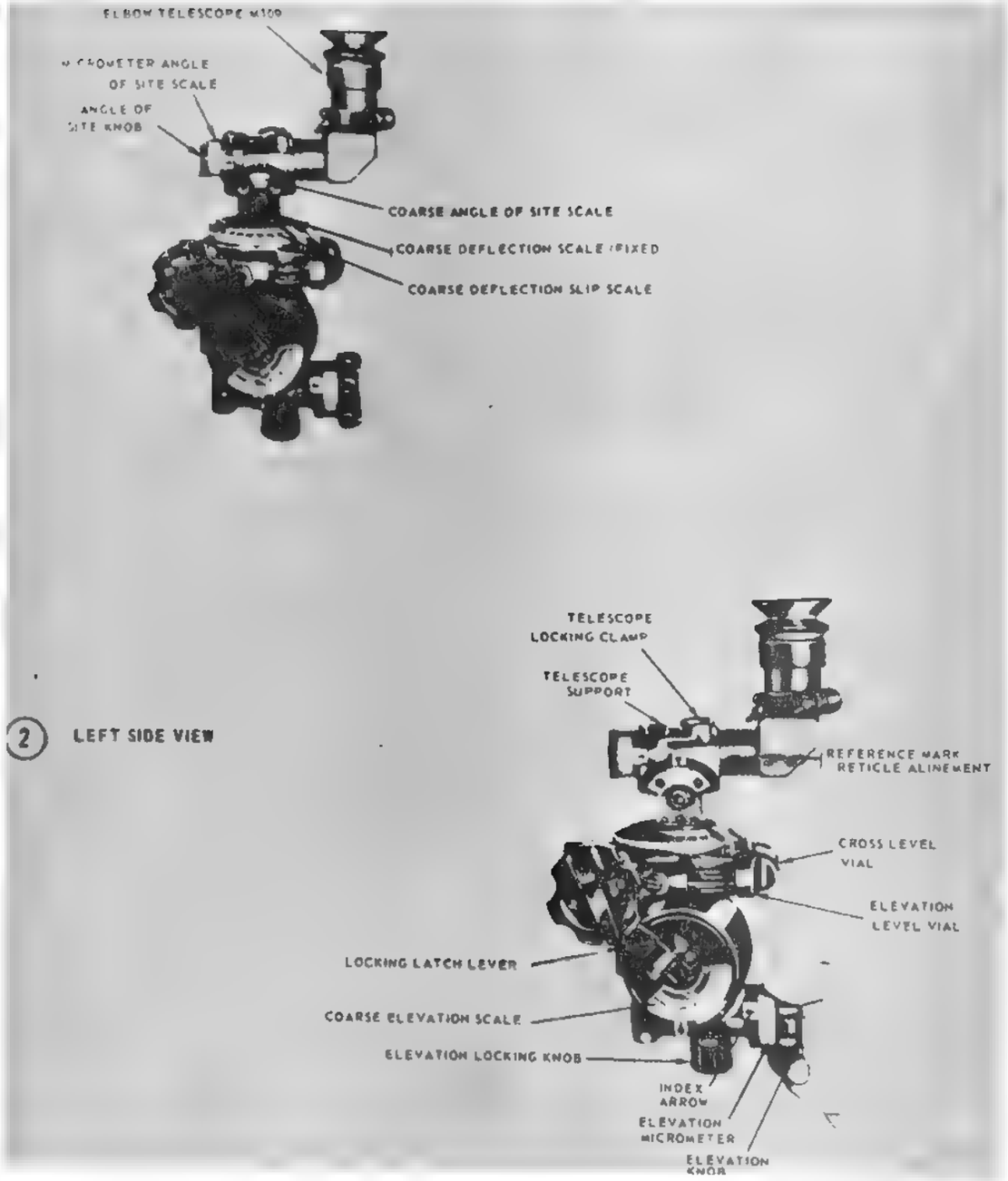


Figure 10.—Continued.

19. Sight Units, M53 and M34A2

The M53 sight unit is the standard sighting device used with the 81-mm mortar. It replaces the M34A2 sight unit. Because the M53 sight unit is issued only as the M34A2 sight units become unserviceable, units may have both types of sight units. Either instrument is used to lay the mortar for elevation and deflection.

20. Sight Unit, M53
(fig 10)

a. General. The M53 sight unit consists of an M128 telescope mount and an M109 elbow telescope fastened together into one unit for operation. The elbow telescope provides magnification and a line of sight from which the weapon is aimed. The telescope mount secures the telescope in the correct position with respect to weapon azimuth and elevation axis.

b. Elbow Telescope, M109.

(1) The M109 elbow telescope (2, fig 10) is a lightweight, 4-power, fixed focus instrument, with a 10° field of view that provides the optical line of sight for aiming the weapon in azimuth and elevation planes.

(2) The telescope incorporates a cross- or lined-mil scale reticle which can be illuminated for night operations. The reticle pattern consists of two centerlines at right angles to each other. Both centerlines are graduated every 5 mils from 5 to 85 and are numbered every 10 mils in all four quadrants on both centerlines.

(3) The telescope can be used in three positions: with the eyepiece to the left, to the right, or up. A telescope locking clamp (1, fig 10) permits the elbow telescope to be moved to any of the three positions and locked in these positions by the locking clamp. Indexes on the telescope and support indicate the horizontal and vertical positions of the centerlines on the reticle when boresighted. The indexes on the telescope and support indicate the plumbed positions of the centerlines. If the indexes are not lined up, the image is tilted.

(4) An angle-of-site mechanism, controlled by an angle-of-site knob, (2, fig 10) moves the telescope in a vertical plane.

(5) An eyepiece provides maximum comfort for the user.

c. Telescope Mount, M128.

(1) *General.* The telescope mount consists of three main parts: lower, center, and upper. The lower part contains a locking lever latch, an elevation micrometer knob with scales, and an elevation locking knob. The center part contains a bushing for vertical axis, a deflection micrometer knob, and deflection locking knob, a stationary and a slip scale, and a pair of level vials. The upper part consists of a telescope support mounted to the central part at a common horizontal axis. The telescope support is fitted with an open sight, a light projection unit, and an angle-of-sight knob with scales.

(2) *Lower part.*

(*a*) A dovetail (1, fig 10) located on the right side of the mount fits into the sight socket on the sight mount assembly to secure the sight unit to the weapon.

(*b*) A dual-purpose locking device in the lower section of the mount locks the dovetail of the sight unit into the sight socket of the sight mount assembly. The locking device is also used to unlock the connection between the dovetail parts for disassembly.

(*c*) A semicircular, course elevation scale (2, fig 10) on the left side has 18 graduations, each graduation representing 100 mils. The graduations are numbered every 200 mils, from minus 2 through 0 to 16. Negative (red) readings are for depression; positive (black) readings are for elevation settings. A reference index is inscribed on the lower part of the casting. The scale settings can be adjusted by loosening the two attaching screws, slipping the scale, and tightening the screws.

(*d*) The elevation knob (2, fig 10) elevates or depresses the line of sight, and is fitted with a crank handle for large changes. Secured to the elevation knob is an adjustable micrometer scale consisting of positive and negative readings, numbered in black for elevation and red for depression. The scale has 100 graduations, each representing 1 mil, and is numbered every 10 mils form 0 to 90. A reference index is inscribed on the main casting. To release the scale for slipping, two screws at the front of the elevation knob must be loosened. A device controlled by a locking knob, (2, fig 10) prevents the elevation knob from rotating during firing.

(3) *Center part.*

(*a*) The fixed deflection scale (2, fig 10) is a nonslip scale of 64 *red* graduations, with each 400 mils numbered in *red* from 0 to 60. The scale rotates with the upper part of the telescope mount when the deflection knob is turned. The deflection knob (2, fig 10) is fitted with a crank for large changes. The index for the scale is on a stationary bracket which is bolted to the main casting. The deflection micrometer scale (2, fig 10) consists of 100 *red* graduations numbered from 0 to 90 in increments of 10 mils. This scale is fastened to the deflection knob. To slip the micrometer scale, two screws at the front of the deflection knob must be loosened. Push the scale toward the sight unit and rotate to the desired setting.

(*b*) The coarse deflection slip scale (2, fig 10) is a large circular scale retained in place by friction and located adjacent to the fixed deflection scale. The slip scale has 64 *black* graduations numbered each 200 mils. The index for the scale is engraved on the main casting. The coarse deflection setting can be changed by depressing the scale and turning.

(*c*) The adjustable micrometer deflection slip scale, also located on the deflection knob, has 100 *black* graduations numbered from 0 to 90 in increments of 10 mils. The scale is retained in place by friction. The scale is fitted with an index attached to the main housing.

(*d*) Two level vials (2, fig 10), located 90° apart on the main housing, are used for leveling the sight unit. Both vials have rotating metal covers to protect them from damage.

(4) *Upper part.* The telescope support (1, fig 10) is equipped with an open sight, a clamping mechanism, and a mechanism for adjusting the angle-of-site reading change.

21. Sight Unit, M34A2
(fig 11)

a. General. The M34A2 sight unit consists of an elbow telescope, a telescope mount, and a telescope adapter fastened together into one unit for operation.

b. Elbow Telescope. This three-power telescope is mounted on the telescope adapter. Its reticle has horizontal and vertical crosslines. The vertical line is used to lay the mortar for direction. An upper thumbscrew clamps the telescope into position. When the screw is loosened, the telescope can be rotated in the plane perpendicular to the line of sight. Rotating it to the horizontal position prevents water from obstructing the view during inclement weather. A lower wingnut permits limited up and down movement to adjust the field of vision. The band assembly on the upper portion of the elbow telescope is grooved to hold the reticle light for night firing.

c. Telescope Mount. The mount consists of an elevation mechanism and a dovetail bracket. The elevation mechanism is made up of an elevation knob and micrometer scale, and elevation scale and index, and an elevation level vial. The elevation scale, graduated in 100-mil intervals, is numbered in 200-mil intervals from minus 200 to plus 1600. The elevation micrometer is graduated in two successive half-circles each with fifty 2-mil increments from 0 to 100. One complete turn of the elevation knob moves the elevation scale 200 mils. The elevation level vial is attached to the main sight housing. A spring-loaded latch on the dovetail bracket locks the sight to the sight mount.

d. Telescope Adapter. The adapter consists of a deflection mechanism, a cross-level vial, an open sight, and the telescope holder. The deflection mechanism is made up of a moving deflection scale with clamp and wingnut, and a fixed index; a deflection scale graduated in sixty-four 100-mil intervals has every fourth graduation numbered from 28 to 0 to the left and 0 to 28 to the right. The deflection micrometer contains one hundred, 1-mil graduations and is numbered every 10 mils from 0 to 90. A throwout device permits free and rapid motion when making large deflection changes. The cross-level vial indicates when the sight unit is cross-leveled and is attached to the telescope adapter. An open sight mounted on the left of the telescope holder remains fixed and parallel to the line of sight of the telescope. It is used as an emergency sight in the event the telescope reticle is damaged. It is also used for approximate laying on the aiming posts when making deflection changes. A button allows the micrometer scale to be slipped for calibration.

22. Operation of Sight Units, M53 and M34A2

a. Attaching the Sight.

(1) *Sight unit, M53.* Insert the dovetail of the telescope mount into the sight socket. Press the locking lever inward, seat the mount firmly, and release the locking lever.

(2) *Sight unit, M34A2.* Insert the dovetail into the sight socket. When the sight is fully seated, the latch snaps into place and secures it in position.

Note. Until the baseplate is firmly seated, remove the sight from the mortar before firing each round.

b. Operation of the M53 Sight Unit.

(1) *Setting for deflection.*

(*a*) To place a deflection setting on the sight, turn the deflection knob. This turns the elbow telescope, the coarse deflection scales, and the deflection micrometer scales. Before attempt-

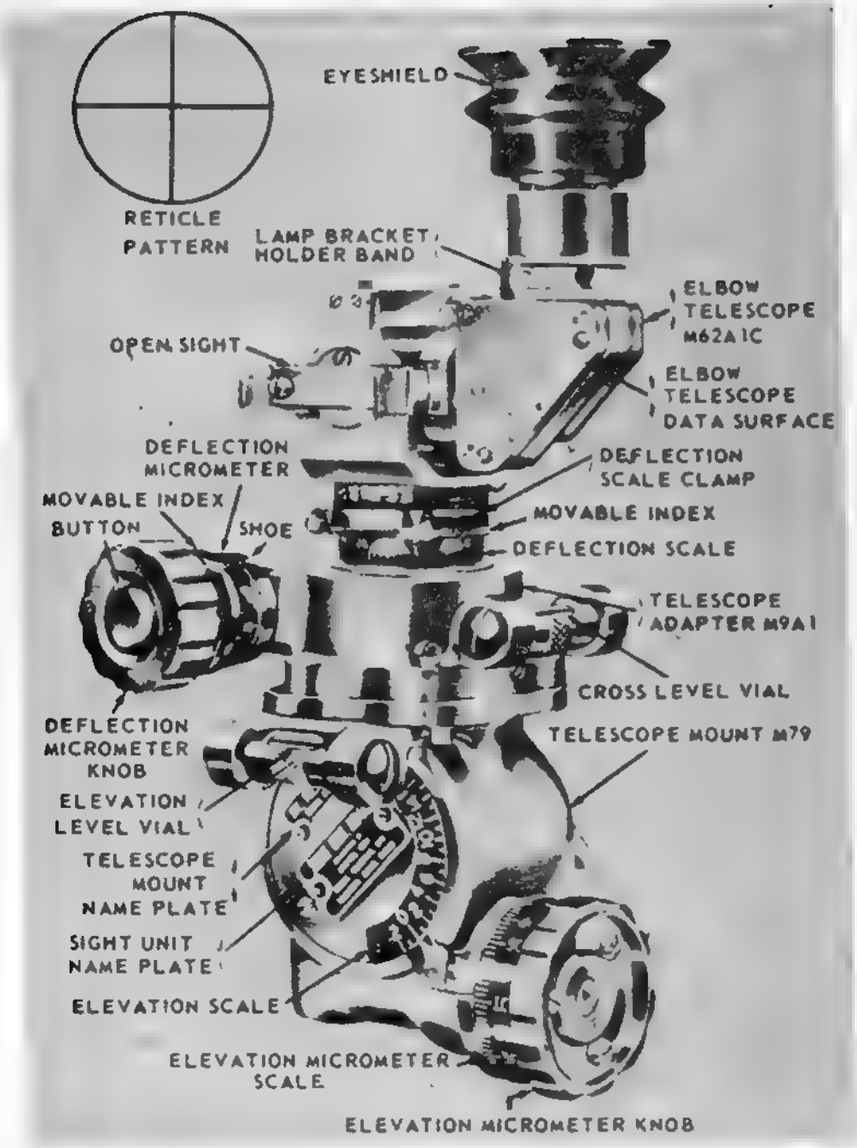


Figure 11. Sight unit, M34A2.

ing to place a deflection setting on the sight unit, insure that the deflection locking knob is released. After placing a setting on the sight, engage the locking knob as this will lock the data onto the sight and insure that the scale does not slip during firing. When setting the deflection, it is necessary to set both the coarse scale and the micrometer scale to obtain the desired setting. Set the first two digits of the deflection on the coarse scale and the last two on the micrometer scale.

(*b*) Setting a deflection on the deflection scale does not change the direction in which the barrel is pointing (the lay of the mortar). It only moves the vertical line off (to the left or right) the aiming line. The deflection placed on the sight is the deflection announced in the fire command. Deflection is placed on the sight before elevation.

(2) *Setting for elevation.*

(*a*) To set for elevation, turn the elevation knob. This operates both the elevation micrometer and coarse elevation scales. Both scales must be set properly to obtain the desired elevation. For example, to place elevation 1065 mils on the M53 sight, turn the elevation knob until the fixed index opposite the moving coarse elevation scale is between the *black* 1000- and 1100-mil graduations on the scale (the graduations are numbered every 200 mils, from minus 2 through 0 to 16) and the 65-mil mark on the elevation micrometer is opposite the fixed index. When making elevation settings, keep in mind that the *black* numbers are for elevation and the *red* numbers are for depression.

(*b*) Setting an elevation on the elevation scale does not change the elevation of the mortar barrel. The elevation to be placed on the sight is announced in the fire command.

(*c*) Before setting elevations on the sight, disengage the elevation locking knob. Once the elevation is placed on the sight, lock the elevation locking knob. This insures the data placed on the sight does not accidentally change.

c. Operation of the M34A2 sight unit.

(1) *Setting for deflection.* To place the deflection setting on the coarse deflection scale, turn the deflection knob. This operates both the deflection micrometer and coarse deflection scales. Both scales must be set properly to obtain the desired deflection. For example, to place a deflection of 2650 mils on the sight, turn the deflection knob until the fixed index opposite the coarse deflection scale is between the 2600- and 2700-mil marks on the scale (every fourth 100-mil graduation is numbered from 0 to 28) and the 50-mil mark on the deflection micrometer is opposite the fixed index. Use care to prevent making a 100-mil error. (For instance, setting the deflection micrometer at 50 mils with the fixed index opposite the coarse deflection scale centered between the 2500- and 2600-mil marks, instead of between 2600 and 2700 mils, will cause a 100-mil error.)

(2) *Setting for elevation.* To set for elevation, turn the elevation knob. This operates both the elevation micrometer and elevation scales. Both scales must be set properly to obtain the desired elevation. For example, to place an elevation of 1065 mils on the sight, turn the elevation knob until the fixed index opposite the moving elevation scale is between the 1000- and 1100-mil graduations on the scale (every other 100-mil graduation is numbered from minus 2 to plus 16) and the "65-mil" mark (by interpolation) on the elevation micrometer is opposite the fixed index.

d. Replacing the sight unit in the carrying case.

(1) *Sight unit, M53.* Before returning the sight unit to the carrying case, close the covers on the level vials and set an elevation of 800 mils and a deflection of 3200 mils on the scales. Place the elbow telescope in the left horizontal position. All crank handles should be folded into the inoperative position. The M53 instrument light is stored in the same case with the rheostat knob down.

(2) *Sight unit, M34A2.* Before returning the sight unit to the carrying case, close the cover on the level vials and set on elevation of 1650 mils and a deflection of 0 and place the elebow telescope in the vertical position. Seat the sight unit properly in the case before closing the cover.

23. Care and Preservation of the Sight Unit

Although the M53 and the M34A2 sight units are rugged, they will not stand abuse or rough handling. Inaccuracy and malfunctioning result from mistreatment. Observe the following precautions:

a. Avoid striking or otherwise damaging any part of the sight. Be particularly careful not to burr or dent the dovetail bracket. Avoid bumping the micrometer knobs, telescope adapter, and level vials. Except when using the sight, keep the metal vial covers closed.

b. Keep the sight in the carrying case when not in use. Keep it as dry as possible, and do not place it in the carrying case while it is damp.

c. When the sight fails to function correctly, return it to the direct support maintenance unit for repair. Members of the mortar crew are *not authorized* to disassemble the sight.

d. Keep the optical parts of the telescope clean and dry. Remove dust from the lens with a clean camel's-hair brush. Use only lens cleaning tissue to wipe these parts. Do not use ordinary polishing liquids, pastes, or abrasives on optical parts. Use only authorized lens cleaning compound for removing grease or oil from the lens.

e. Occasionally oil only the sight locking devices by using a *small* quantity of light (PL) preservative lubricating oil. To prevent accumulation of dust and grit, wipe off excess lubricant that seeps from moving parts. Care should be taken to insure that no oil is allowed to get on the deflection and elevation scales. (Oil will remove the paint from the deflection scale.)

24. Instrument Light, M53

a. The M53 instrument light (fig 13) illuminates the reticle of the M109 elbow telescope and scales of the M128 telescope mount during night operations. This instrument light is the standard night light used with the 81-mm mortar, M29A1.

b. The light consists principally of two flash-

light batteries, a battery case, a rheostat knob, and two separate light assemblies attached to a pair of flexible lead wires extending from one end of the battery case. Because the wires are coiled, the leads can be extended from a normal length of 2 feet to approximately 6 feet.

Figure 12. Carrying case, M166.

c. One light assembly consists of a bracket assembly that can be screwed into the lamp bracket holder for lighting the elbow telescope reticle. This light is turned on and off by the rheostat knob. The knob is also used to increase or decrease the intensity of the illumination when the lamp is on. The second light assembly is a hand light that can be directed upon the telescope mount scales or the level vials as required. The on-off switch for this light is located on the hand light (fig 13).

d. To place the M53 instrument light into operation, press inward on the cap at the end of the battery case and turn the cap counterclockwise until free. Insert two BA–30 batteries, terminal ends first. Install the cap by turning clockwise until finger tight. Install the battery case of the light in the carrying case with the rheostat knob accessible. Position the carrying case so the lead wires reach the sight unit. Remove the dust cover from the lamp bracket holder of the M109 elbow telescope, and remove the protective cap from the end of the light assembly lead and stow it in the case. Thread the end of the light assembly into the socket on the elbow telescope for illuminating the telescope reticle. Retain the hand light in the case until required for use. Do not attempt to use the M53 light on the light projector of the M53 sight.

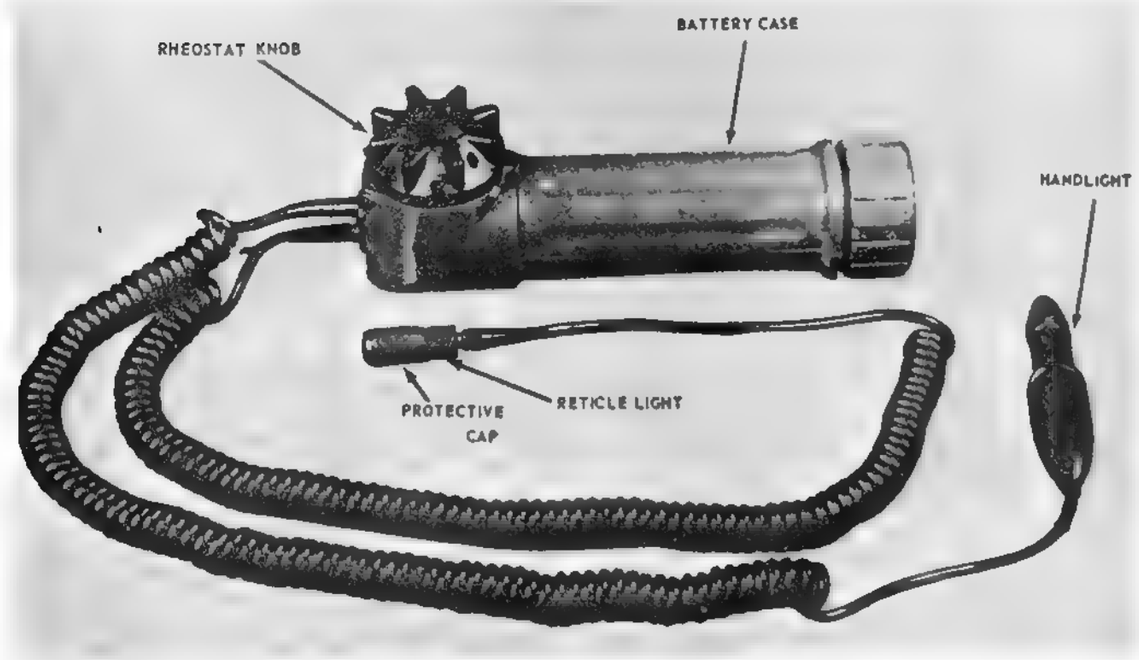
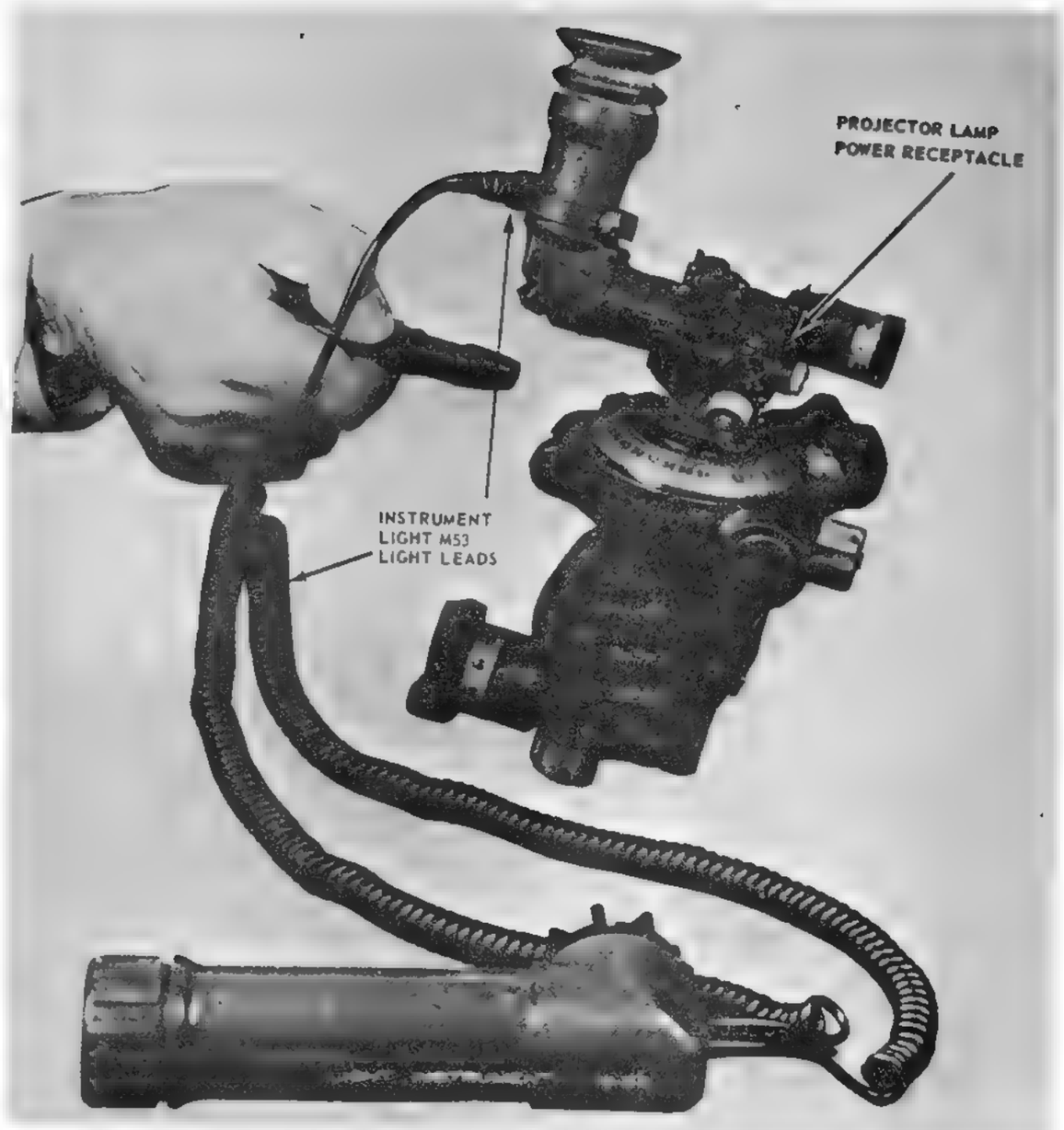


Figure 13. Instrument light, M53.



Installing instrument light, M53
Figure 13.—Continued.

25. Carrying Case, M166
(fig 12)

The M166 carrying case is a lightweight, sturdy case with an isofoam bed that provides storage for the M53 sight unit and the M53 instrument light.

26. Instrument Light, M42

The M42 instrument light (fig 14) illuminates the sight reticle of the M34A2 sight unit. Two

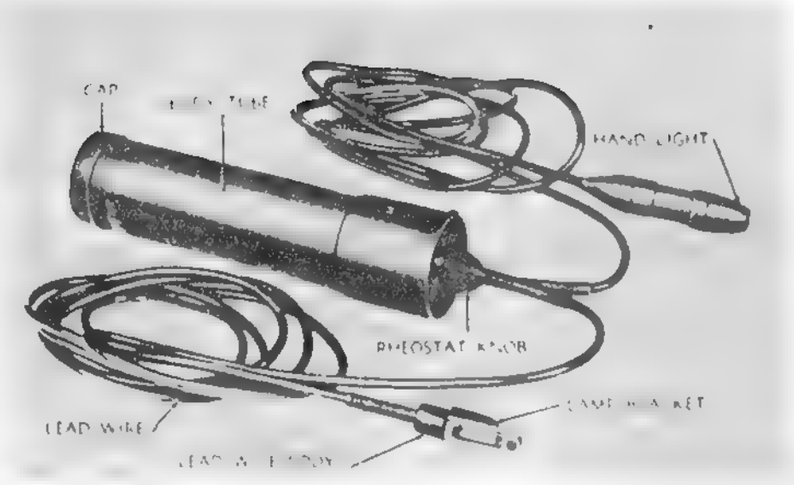


Figure 14. Instrument light, M42.

BA–20 batteries provide the power. To attach the light to the elbow telescope, insert the lamp bracket in the grooved slot on the band assembly. A hand light on a flexible cord is provided to illuminate the scales and the level vials. A rheostat knob on top of the battery case turns both lights on or off and controls the brightness of the reticle light. Turn off the lights when they are not in use. When placing the instrument in the carrying case, remove the batteries and place them in the space provided.

27. Carrying Case, M78
(fig 14)

The M78 carrying case is a waterproof, metal case used for safekeeping the M34A2 sight unit and the M42 instrument light.

28. Aiming Post, M1A2

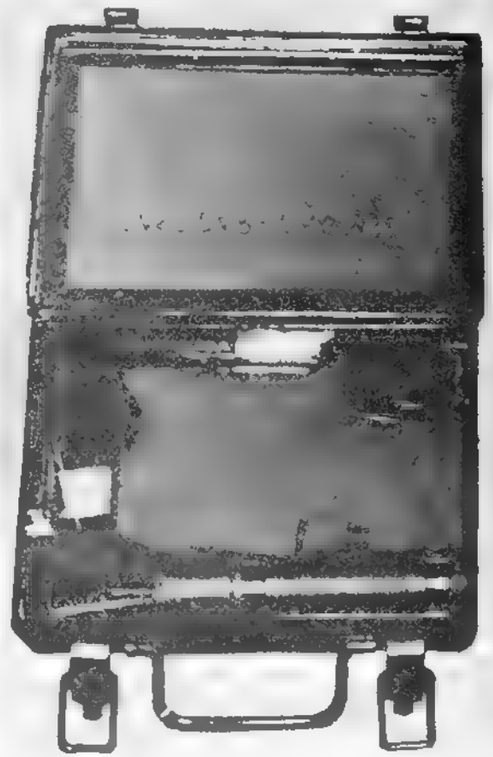
Two M1A2 aiming posts are provided with the mortar. They are used to extablish a reference line to aim the mortar.

29. Aiming Post Light, M14

The M14 aiming post light (fig 15) is used with the M42 instrument light for night firing. It consists of a brass case for housing two flashlight batteries, a light bulb, and a switch. The light is provided with colored filters and shaded with a hood. The entire unit is clamped to the aiming post.

30. Boresight, M45

a. General. The M45 boresight (fig 16) consists of an elbow telescope, a telescope clamp, a body, two strap assemblies, and a clamp assembly.



Carrying case M78 with instrument light, M42

Figure 14.—Continued.

(1) The elbow telescope establishes a definite line of sight.

(2) The telescope clamp maintains that line of sight in the plane established by the centerline of the V-slides.

(3) The body incorporates two perpendicular V-slides. It contains level vials (preset at 800 mils elevation) that are used to determine the angle of elevation of 800 mils and whether the V-slides are in perpendicular positions. It also provides the hardware to which the straps are attached.

(4) Two straps are supplied with each boresight and marked for cutting in the field to the size required for any mortar.

(5) The clamp assembly applies tension to the strap assemblies to secure the boresight against the mortar barrel.

b. Principles of Operation. The boresight is constructed so that the telescope line of sight lies in the plane established by the centerlines of the V-slides. When properly secured to a mortar barrel, the centerline of the contacting V-slide is parallel to the centerline of the barrel. Further, the cross-level vial, when centered, indicates that the centerlines of both slides, the elbow telescope, and the barrel lie in the same vertical plane. Therefore, the line of sight of the telescope coincides with the axis of the barrel, regardless of which V-slide of the boresight is contacting the barrel. The elevation vial is constructed with a fixed elevation of 800 mils.

c. Installation.

(1) Remove the boresight, the clamp assembly, and the straps from the carrying case. Grasp the boresight by the body to prevent damaging the telescope.

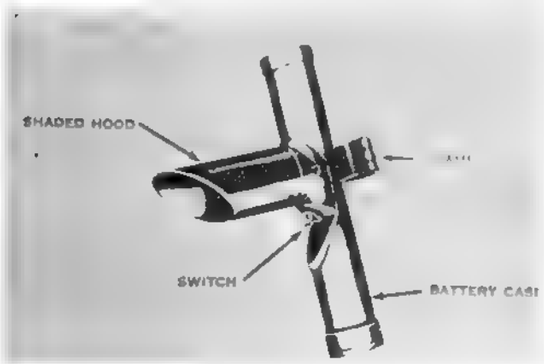


Figure 15. M14 aiming post light.

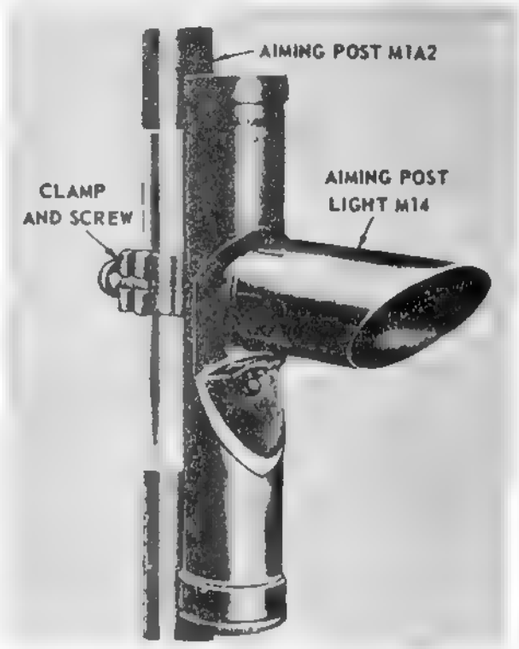
(2) Place the ring over the hook and attach the strap snap to the eye provided on the strap shaft.

(3) If necessary, release the catches and reset the straps to the proper length.

(4) Remove any burrs or projecting paint imperfections from the seating area of the mortar barrel to insure proper seating of the boresight. Position the sight approximately 1 inch from the muzzle of the barrel as shown in figure 16.

31. Sight Calibration

Always calibrate the mortar sight to the mortar on which it is to be mounted. This procedure is necessary since the sight socket that receives the sight unit is a machined part and will vary in accuracy with each mortar. There is no set rule for frequency of calibration. Generally, the sight should be calibrated each time the mortar is mounted in a new location, since the movement might disturb the setting of the elevation and deflection scales. The time available and the accuracy desired will dictate the frequency of calibration.



Aiming post light M14 on aiming post M1A2

Figure 15.—Continued.

32. Boresight Method of Calibration

a. General. Once the mortar has been mounted, place the M53 sight unit or the M34A2 sight unit into position in the sight socket. Using the M53 sight, place a reading of 3200 mils on the fixed deflection (red) scale and an elevation of 800 mils. Using the M34A2 sight, place a deflection of zero and an elevation of 800 mils on the sight. Aline the vertical crossline of the sight on an aiming point (at least 200 meters distant) by shifting the bridge assembly. If necessary use the traversing mechanism; however, keep the mortar within two turns of center of traverse. Make a visual check of the mortar for cant; if cant exists, remove this cant and re-lay, if necessary. (For a detailed discussion of the boresight method of calibration.)

b. Elevation Setting.

(1) Install the boresight on the mortar barrel as shown in figure 16. Center the cross-level vial by rotating the boresight slightly around the outside diameter of the mortar barrel. Slight movements may be made by loosening the clamp screw and lightly tapping the boresight body. When the bubble centers, tighten the clamp screw.

(2) Elevate the mortar barrel until the boresight elevation level vial is centered. The mortar is now set at 800 mils (45°) elevation.

(3) Using the elevation knob, elevate or lower the sight unit until the elevation level bubble is centered. If necessary, cross-level the sight unit.

(4) *Recheck* all level bubbles.

(5) The reading on the coarse elevation scale of the sight unit should be 800 mils and the reading on the elevation micrometer scale should be 0. If adjustment is necessary, proceed as indicated in (*a*) and (*b*) below.

(*a*) Loosen the two screws which secure the coarse elevation scale and slip the scale until the 800-mil mark on the scale coincides with the reference mark on the housing. Tighten the two screws to secure the scales.

(*b*) Loosen the three screws on the elevation knob and slip the elevation micrometer scale until the 0 mark on the micrometer scale coincides with the reference mark on the housing. Tighten the three screws to secure the micrometer scale.

(6) *Recheck* all level bubbles.

c. Deflection Setting.

(1) Check again to insure that the sight setting reads 3200 on the fixed deflection (red) scale and elevation 800 mils.

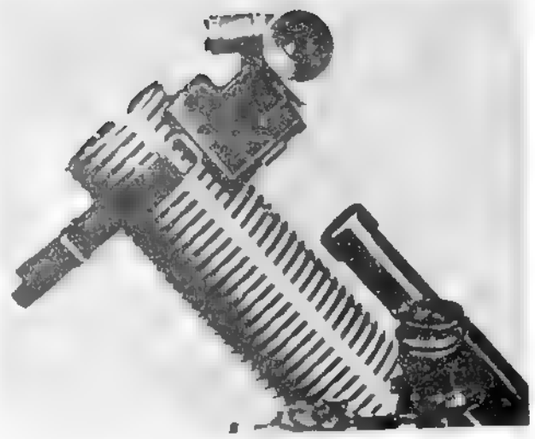


Figure 16. Boresight, M45.

(2) By traversing the mortar no more than two turns of center of traverse, aline the vertical crossline of the boresight on the original aiming point. Adjust the boresight to keep the cross-level bubble centered since the mortar may cant as the mortar is traversed. (If the mortar is initially mounted on the aiming point, it will decrease the amount of traverse necessary to aline the crossline on the aiming point.) It may also be necessary to center the elevation level bubble. After the boresight is alined on the aiming point, level the sight by centering the cross-level bubble. Rotate the deflection micrometer knob until the sight is alined on the aiming point. The coarse deflection scale should read 3200 mils and the micrometer scales should read 0. If adjustment is necessary, proceed as indicated. Loosen the two boresight locking screws on the deflection knob and slip the micrometer deflection scale until the arrow on the index is alined with the zero mark on the micrometer scale.

(3) Check all level bubbles, the sight unit, and the boresight.

(4) Using the M34A2 sight unit, adjust the deflection scale and micrometer scale of the sight unit to zero. To do this, loosen the deflection scale retaining wingnut and slip the scale to zero. Adjust the deflection micrometer scale to zero by pushing in on the micrometer knob retaining button and slipping the scale to zero.

Note. The M53 sight unit should be received from the manufacturer with the red deflection scale calibrated on 3200. If it is not, turn the sight unit in to direct support maintenance for calibration.

d. Verification of Accuracy. The M45 boresight is adjusted by the manufacturer and it should not require readjustment as a result of normal field handling. If inaccurate, turn in to direct support maintenance.

e. Removal.

(1) Loosen the clamp screw, releasing the boresight from the barrel.

(2) Swing the elbow telescope until it is approximately parallel with the elevation level bubble.

(3) Release the clamp assembly and straps by removing the ring from the hook and the strap shaft.

(4) Stow the clamp assembly and straps in the corner compartment. Put the boresight in the center compartment of the carrying case.

33. Calibration for Elevation Using the M2 Compass When Boresight Is Not Available

a. Mount the mortar on level ground and center the traversing bearing.

b. With an M2 compass, elevate the barrel to an elevation of 800 mils.

(1) Set the elevation of 800 on the elevation scale in the M2 compass.

(2) Turn the compass on its left side as when reading angle of site and lay it on the top of the mortar barrel.

(3) Elevate the mortar until the bubble is centered in the vial.

c. Crosslevel the mortar, using the adjusting nut.

d. Center the elevation bubble by turning the elevation micrometer knob on the sight unit.

e. If the reading of the elevation scale of the sight is not 800 mils, and the reading on the elevation micrometer is not 0, make adjustments for elevation as outlined in paragraphs 32*b* (2)–(5).

f. Recheck the readings of the compass and the sight unit. If the readings are not identical, repeat the procedure outlined above.

34. Two Methods of Calibrating Sight for Deflection

a. Calibration for Deflection, Using Aiming Circle (Angle Method) When Boresight Is Not Available.

(1) Set up the aiming circle 25 meters to the rear of the mounted mortar (800 mils elevation).

(2) With the azimuth scale and micrometer of the aiming circle at 0, aline the center of the reticle on the center of the baseplug of the mortar.

(3) Traverse and crosslevel the mortar until the center axis of the barrel from the baseplug to the muzzle is alined with the vertical line of the aiming circle telescope reticle (fig 17).

(4) Turn the deflection knob of the sight until the vertical line is centered on the lens of the aiming circle and read Angle A, opposite the fixed index (fig 17).

(5) Turn the azimuth micrometer knob of the aiming circle until the vertical line of the telescope is laid on the center of the sight lens and read Angle B, opposite the azimuth scale index. If the sight is in calibration, angles will be equal. If they are not equal, the sight is adjusted as follows: Loosen the two boresight locking screws on the deflection knob and slip the micrometer deflection scale until the arrow on the index is alined with the zero mark on the micrometer scale.

b. Calibration for Deflection, Using Aiming Circle When Boresight Is Not Available.

(1) Set up the aiming circle and aline the vertical line on a distant aiming point (a sharp, distinct object not less than 200 meters distant).

(2) Mount the mortar on level ground approximately 25 meters from the aiming circle and on the line between the aiming circle and the distant aiming point. Center the traversing bearing and crosslevel.

(3) With the vertical line of the aiming circle still laid on the distant aiming point, move the mortar baseplate until the center of the baseplug is alined with the vertical line of the aiming circle. Traverse and crosslevel until the axis of the barrel, from baseplug to muzzle, is alined with the vertical line of the aiming circle.

(4) Lay the vertical line of the sight unit on the same distant aiming point. If the sight is calibrated, the deflection reading will be 3200. If the deflection is not 3200, the sight is adjusted as in paragraph 32*c*(2).

35. Expedient Method of Calibrating the Sight for Deflection Using the Sight Case as an Aiming Point

a. Place the boresight on the barrel as outlined in paragraph 30*c*(1)–(4).

b. Check to insure that the sight setting reads 3200 on the fixed deflection (red) scale and elevation 800 mils.

c. Place the sight case so that the long axis of the case is perpendicular to the barrel 25 meters from the mortar position.

d. By traversing the mortar no more than two turns from center of traverse, lay the vertical line of the boresight device on the right edge of the sight case.

e. Using the deflection micrometer knob, lay the vertical cross line of the sight on the left edge of the sight case. If the deflection reading is not 3200, proceed as indicated. Loosen the two boresight locking screws on the deflection knob and slip the micrometer deflection scale until the arrow on the index is alined with the zero mark on the micrometer scale.

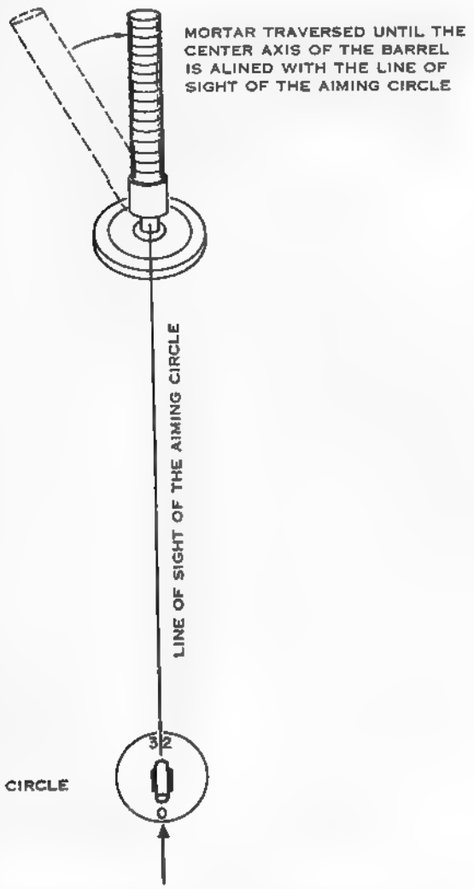
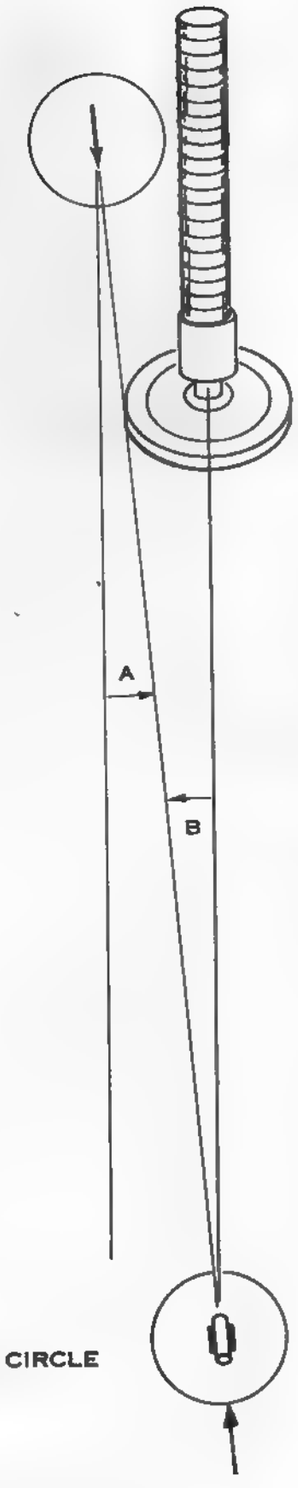


Figure 17. Alining mortar barrel with vertical line of aiming circle telescope reticle.

M53 SIGHT



Determining angle A

Figure 17.—Continued.

36. Compass, M2

a. General. The M2 compass (fig 18) is used to measure azimuths or angles of site. It measures magnetic azimuths or, when the instrument has been declinated for the locality, grid azimuths. (For technical information, see TM 9–1290–333–15.)

b. Description. The principal parts of the compass are—

(1) *Compass body assembly.* This assembly consists of a circular glass window that covers and keeps dust and moisture from the interior of the instrument, thus protecting the compass needle and angle-of-site mechanism. A hinge assembly holds the compass cover in the position in which it is placed. A hole in the cover coincides with a small oval window in the mirror on the inside of the cover. A sighting line is etched across the face of the mirror.

(2) *Angle-of-site mechanism.* The angle of site mechanism is attached to the bottom of the compass body. It consists of an actuating (leveling) lever located on the back of the compass, a leveling assembly with a tubular elevation level, and a circular level. The instrument is leveled with the circular level to read azimuths, and with the elevation level to read angle of site. The elevation (angle-of-site) scale and the four points of the compass, represented by three letters and a star, are engraved on the inside bottom of the compass body. The elevation scale is graduated in two directions; in each direction it is graduated from 0 to 1200 mils in 20-mil increments and numbered every 200 mils.

(3) *Magnetic needle and lifting mechanism.* The magnetic needle assembly consists of a magnetized needle and a jewel housing that serves as a pivot. The north-seeking end of the needle is white. On some compasses a thin piece of copper wire is wrapped around the needle for counterbalance. A lifting pin projects slightly above the top rim of the compass body. The lower end of the pin engages the needle-lifting lever. When the cover is closed, the magnetic needle is automatically lifted from its pivot and held firmly against the window of the compass.

(4) *Azimuth scale and adjuster.* The azimuth scale is a circular dial geared to the azimuth scale adjuster. This permits the azimuth scale to be rotated approximately 900 mils in either direction. The azimuth index provides a means of orienting the azimuth scale at 0 or the declination constant of the locality. The azimuth scale is graduated from 0 to 6400 in 20-mil increments, and numbered at 200-mil intervals.

(5) *Front and rear sight.* The front sight is hinged to the compass cover and may be folded into its bracket when not in use. The rear sight is made in two parts, a rear sight and a holder. When the compass is not being used, the rear sight and holder are folded across the compass body and the cover is closed.

c. Use of the Compass. The compass should be held as steadily as possible to obtain the most accurate readings. The use of a sitting or prone position, a rest for the hand or elbows, or a solid nonmetallic support will help to eliminate unintentional movement of the instrument. When being used to measure azimuths, the compass *must not* be near metallic objects.

(1) To measure a magnetic azimuth—

(*a*) Zero the azimuth scale by turning the scale adjuster.

(*b*) Place the cover at an angle of approximately 45° to the face of the compass so that the scale reflection will be viewed in the mirror.

(*c*) Adjust the sights to the desired position. Sight the compass by any of these methods:

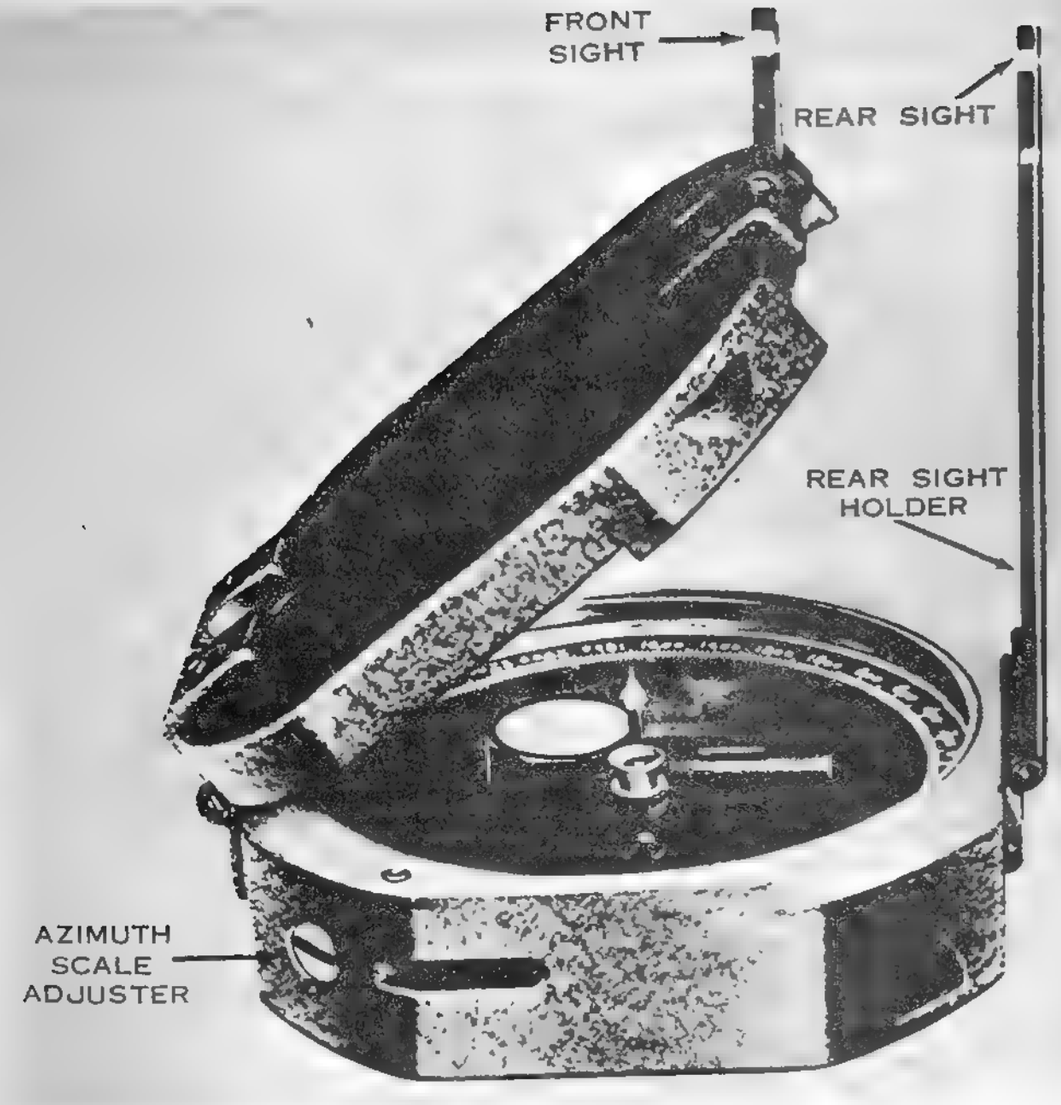
1. Raise the rear sight holder approximately perpendicular to the face of the compass. Sight on the object through the opening in the rear sight holder and through the window in the cover. The compass is correctly sighted when it is level and when the black centerline of the window bisects the object and the opening in the rear sight.

2. Fold the rear sight holder out parallel with the face of the compass, with the rear sight perpendicular to its holder. Sight through the window in the cover. If the object sighted is at a lower elevation than the compass, raise the rear sight holder as needed. The compass is correctly sighted when it is level and the black centerline of the window, the rear sight, and the object are alined.

3. Raise the front sight and the rear sight perpendicular to the face of the compass (2 and 3, fig 18). Sight over the tips of the rear and front sights. The compass is correctly sighted when it is level and the tips of the sights and the object are alined.

(*d*) Hold the compass in both hands, at eye level, with the arms braced against the body and with the rear sight near the eyes. For very precise measurements, rest the compass on a nonmetallic stake or object.

(*e*) Level the instrument by viewing the circular level in the mirror, moving the compass until the bubble is centered. Sight on the object, look in the mirror, and read the azimuth indicated by the black end of the magnetic needle.



1. Side view

Figure 18. Compass, M2.

Note. If the front sight is nearest your body, read the white end of the needle.

(2) To measure a grid azimuth—

(*a*) Index the known declination constant on the azimuth scale by turning the azimuth scale adjuster. Be sure to loosen the locking screw on the bottom of the compass.

(*b*) Measure the azimuth as described in *c*. (1) (*b*) through (*e*) above. The azimuth measured is a grid azimuth.

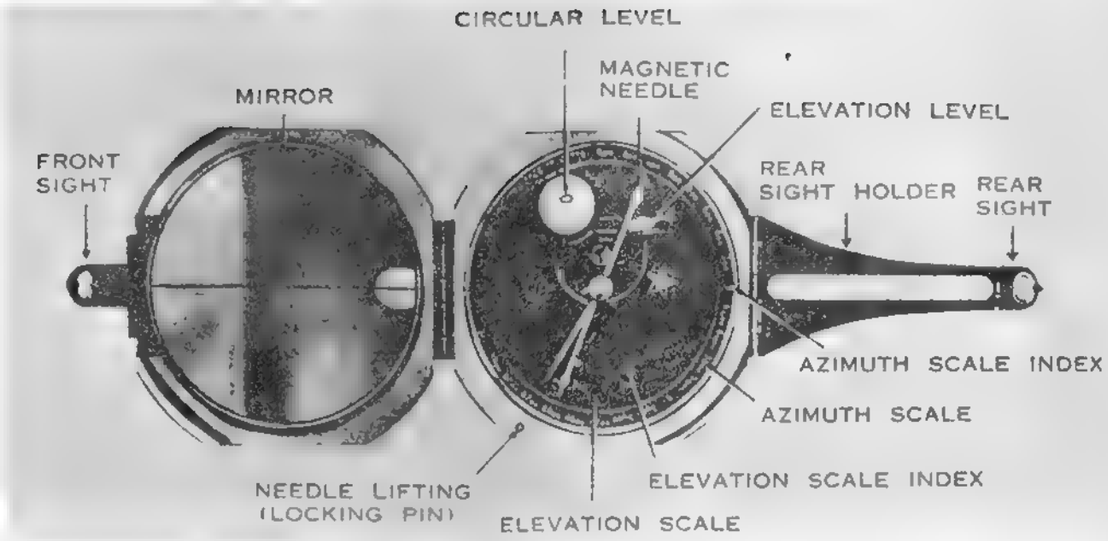
(3) To measure an angle of site, or a vertical angle from the horizontal—

(*a*) Hold the compass with the left side down (cover to the left) and fold the rear sight holder out parallel to the face of the compass, with the rear sight perpendicular to the holder. Position the cover so that, when looking through the rear sight and the aperture in the cover, you see the elevation vial reflected in the mirror.

(*b*) Sight on the point to be measured.

(*c*) Center the bubble in the elevation level vial (reflected in the mirror) with the level lever.

(*d*) Read the angle on the elevation scale



2. Top view

Figure 18.—Continued.

opposite the index mark. The section of the scale graduated counterclockwise from 0 to 1200 mils measures plus angles of site. The section of the scale graduated clockwise from 0 to 1200 mils measures minus angles of site.

37. Aiming Circle, M2

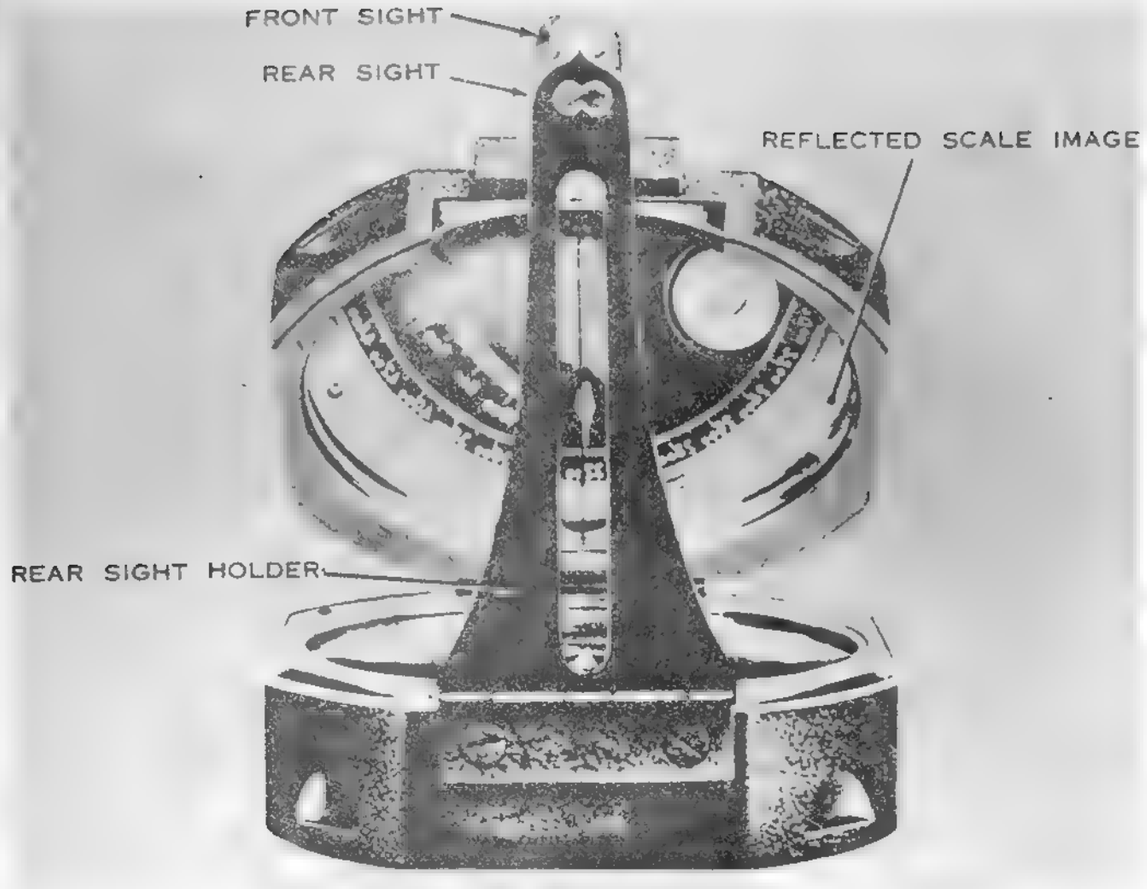
a. Description. The M2 aiming circle consists basically of an elbow telescope mounted on orienting and elevating mechanisms which are contained within a main housing. The main housing, in turn, is supported by adjusting screws through the baseplate.

b. Use. The M2 aiming circle with its accessory equipment (1, fig 19) has the general characteristics of a surveyor's transit. It is used for the precise measurement of the azimuth and elevation angles of a ground or aerial target with respect to a preselected baseline as required for the orientation of indirect fire weapons. It can also be used for general topographical surveying. (For detailed information, see TM 9–1290–262–35.)

(1) The orienting and elevating mechanisms permit unlimited azimuth orienting movement (360° (6400 mils)) and limited elevation and depression (1,260 mils). Azimuth orienting rotation is controlled by two orienting knobs (1 and 2, fig 19). Azimuth measurement is controlled by the micrometer knob. Elevation and depression movement is controlled by the elevation micrometer knob. The azimuth micrometer worm can be disengaged to provide rapid azimuth measure of movement by exerting pressure on the azimuth micrometer knob against the pressure of an internal spring-loaded plunger. Releasing the pressure on the azimuth micrometer knob will allow the mechanism to re-engage. A similar throwout mechanism permits the azimuth orienting worm to also be disengaged to provide rapid azimuth orienting movement.

(2) The telescope of the aiming circle is a four-power, fixed-focus elbow-type instrument. The reticle of the telescope contains crosslines graduated to give azimuth and elevation angular readings from 0 to 85 mils in 5-mil increments. This permits the observer to read small angular values directly from the reticle without the necessity of referring to the azimuth and elevation micrometer scales. An externally stowed filter is provided for protection against the rays of the sun. A slotted bracket provides the means of securing the lamp bracket on one lead wire of the M51 instrument light so that illumination of the reticle during night operation may be accomplished. The reflector can be illuminated and used in conjunction with the sight units on the mortars during night operations to backsight the vertical centerline of the aiming circle.

(3) Three levels are contained within the



3. Compass, M2 (user's view)

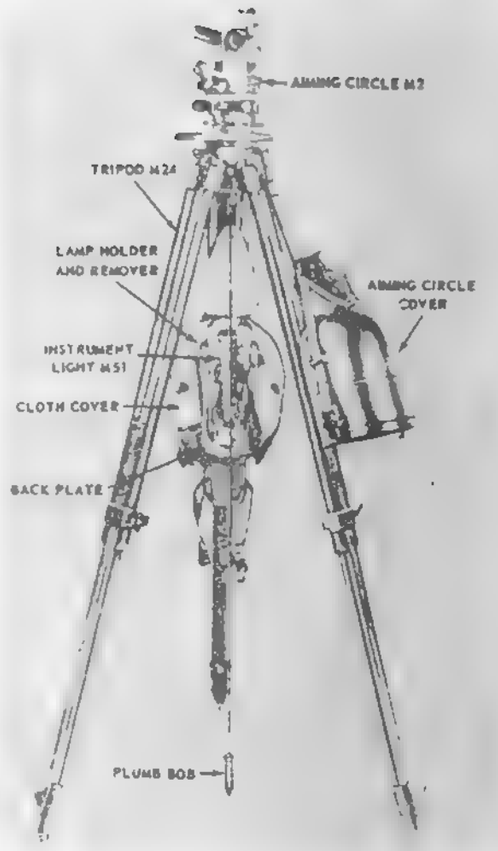
Figure 18.—Continued.

telescope body and main housing of the aiming circle. One tubular level, held between two bosses on the telescope body, is used to establish a truly horizontal line-of-sight. The two bosses supporting this level are machined to form an open sight for approximate alinement of the telescope and target, and for quick or emergency sighting. One circular level and one tubular level are held within bosses on the main housing. The circular level is used for rough leveling of the aiming circle and the tubular level is used for fine leveling adjustments. The three leveling screws on the baseplate are used to level the instrument and each is controlled by a leveling screw knob.

(4) A magnetic compass needle is located in a recess in the top of the housing. A magnifier and rectangular reticle located at one end of the recess enable the observer to observe the end of the compass needle and aline the line-of-sight of the telescope with the needle. The compass needle may be locked in position by actuating the locking lever on the side of the housing.

(5) Azimuth and elevation scales are employed to measure accurate azimuth or elevation angles. The scales provide coarse readings and the micrometer provides fine reading. The two readings added together give the angle. Graduation intervals and numeral scales are graduated into relatively large round number intervals for convenience in reading. The scale intervals are in graduations of 100 mils.

(*a*) Azimuth scale is graduated 0–6,400 mils (zero equals 6,400). The upper series forms the main azimuth scale, colored black, and numbered at 200-mil intervals. The lower series, colored red, is numbered 0–3,200 mils; the large zero in main scale is equivalent to 3,200.



1. With accessory equipment
Aiming circle, M2

Figure 19.

(*b*) The azimuth micrometer scale is graduated at 1-mil intervals and numbered from 0–100 at ten 10-mil intervals.

(*c*) The elevation scale is graduated and numbered on both sides of 0. Minus (red) readings represent depression and plus (black) readings represent elevations at 100-mil intervals from minus 400 to 800 mils.

(*d*) The elevation micrometer is graduated at 1-mil intervals, from 0 to 99 mils; large zero designated 0 and 100. Red numeral represents depression and black numeral represents elevation.

(6) A notation strip is provided on the baseplate. This strip is a raised and machined surface on which scale readings, settings, or other data may be recorded for reference.

c. Accessory Equipment. The accessory equipment for the M2 aiming circle includes the aiming circle cover, M24 tripod, and the accessory kit which includes the M51 instrument light, backplate, cloth cover, plumb bob, and a lamp holder and remover. This equipment is mounted on the M24 tripos when the instrument is set up for use.

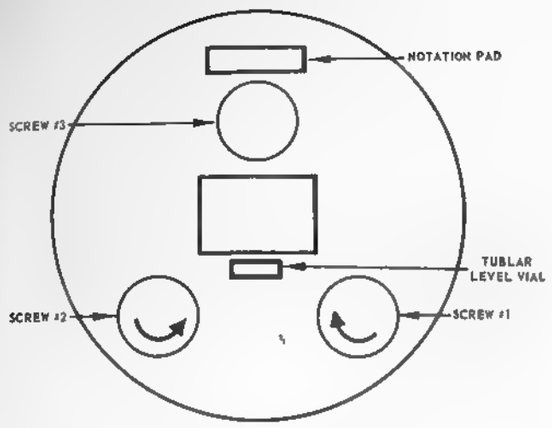
(1) The aiming circle cover is a metal cover which serves to protect and house the aiming circle when it is not in use. It attaches to the baseplate of the aiming circle and may be carried by means of its strap. When the aiming circle is in use, the cover is placed on the tripod head cover.

(2) The M24 tripod (1, fig 19) is composed of three telescoping wooden legs hinged to a metal head which contains a captive screw for attaching the aiming circle. When not in use, the tripod cover should be fitted on the head to protect the head and captive screw against damage, and the legs are held retracted by a strap. Attachments are provided so that the aiming circle cover ((1) above) and the cloth cover with attached accessory equipment ((5) below) may be mounted on its legs when the aiming circle is set up for use. A hook is also provided from which the plumb bob may be suspended by means of its attaching thread when it is in use.

(3) The M51 instrument light is a lighting device for use with M2 aiming circle during night operations and for certain test and adjustment procedures. The light is flashlight-battery powered and contains two attaching lead wires. A lamp bracket attached to one lead wire can be inserted into the slotted bracket of the aiming circle telescope for illumination of the telescope reticle. A hand light, attached to the other lead wire, can be used for general purpose illumination (scales, level vials, reflector, compass needle, etc.). Rotation of the rheostat knob turns the two lamps on and off and increases or decreases the intensity of illumination.

(4) The backplate provides the necessary clips and attachments for securing and protecting the instrument light and the lamp bracket, hand light, and lead wires of the light. The plate with the attached instrument light is stored within the cloth cover.

(5) The cloth cover is used to store the backplate and attached M51 instrument light. It is also used to store the plumb bob and a lampholder and remover. When the aiming circle is set up for use, the cloth cover with attached equipment is mounted on one of the legs of the M24 tripod (1, fig 19). When not in use, attached snap fasteners keep the cover in closed position.



4. Leveling screws

Figure 19.—Continued.

d. Tabulated data.

Weight (w/o equipment)	8 lb. 2 oz.
Weight (w/equipment less batteries)	21.99 lb.
Azimuth rotation	6,400 mils
Elevation (maximum)	830 mils
Depression (maximum)	430 mils
Magnification	4 power
Field of view	10 degrees

e. Setting Up and Leveling the Instrument. The aiming circle must always be level while operating.

(1) Unstrap the tripod legs, loosen the leg clamp thumbscrews, extend the legs so that the tripod is approximately chest high, and tighten the leg clamp thumbscrews. Spread the legs approximately 18 inches apart, and plant the feet firmly in the ground; adjust the legs so the tripod head is approximately level.

(2) Remove the tripod head cover. Open the baseplate cover of the aiming circle head and thread the tripod guide screw assembly into the aiming circle until it is firmly seated. Pull cut and down on the strap latch assembly. Remove the cover and hang it on the tripod head cover.

(3) If the instrument is to be set up over a particular point, attach the plumb bob to the hook and adjust the tripod legs and aiming circle head until it is over the point.

(4) Loosen the leveling screws to expose sufficient threads (3/8 to 1/2 an inch) on the three screws to permit the instrument to be leveled. Number the leveling screws clockwise, 1, 2, and 3 (see 4, fig 19). Now place the tubular level vial over leveling screws 1 and 2 so that the long axis of the tubular level is parallel to an imaginary line running through the center of these two leveling screws. Grasp leveling screw number 1 between the thumb and forefinger of the right hand, grasp leveling screw number 2 between the thumb and forefinger of the left hand. Turn the screws so that the thumbs move toward or away from each other. Using these two leveling screws, center the bubble. The bubble will move in the same direction as the left thumb. Rotate the aiming circle head until the tubular level vial is perpendicular to its original position. Level the tubular level by turning level screw number 3 only. The bubble should now remain level in any direction that the aiming circle is rotated. A variation of one graduation from the center of the vial is acceptable. If the bubble does not remain level, repeat the procedure above.

Note. If the spring plate is bent, the aiming circle cannot be leveled and must be turned into the Direct Support Maintenance unit.

(5) With the aiming circle level, turn the elevation micrometer knob until the bubble in the level attached to the telescope is centered. The elevation scale and the elevation micrometer should read zero. If they do not, the reading on these scales with the sign reversed is the vertical angle correction and must be added algebraically to all vertical angles measured with the instrument.

(6) When setting up the aiming circle it should be set up at the distance indicated from the following objects:

Object	*Distance (meters)*
High tension power lines	150
Electronic equipment	150
Railroad tracks	75
Tanks and trucks	75
Vehicles	50
Barbed wire	30
Mortars or telegraph wires	25
Helmets, etc.	10

f. Declination Constant. Since the magnetic needle of an aiming circle does not point to the grid north determined from a map, it is necessary to correct for this difference by using the declination constant. The declination constant of an instrument is the clockwise angle between grid north and magnetic north; that is, the grid azimuth of magnetic north. This constant differs slightly for different instruments and therefore must be recorded on each instrument. The constant also differs in different localities for the same instrument.

g. Determining the Declination Constant.

(1) *Declination station.* Declination stations are established by corps artillery, division artillery and, in some cases, artillery battalion survey teams, to determine the declination constants of instruments and to correct for local attractions, annual variations, and instrument errors. When a unit moves from one locality to another, a station should be established where all instruments are declinated. If the declination constants for all instruments of a unit are determined at the same station, grid azimuths measured with each instrument will be in agreement with the map grid, and all instruments will be in agreement with each other. The point chosen for the declination station must have a view of at least two distant, well-defined points with a know grid azimuth. Two additional points are desirable, one in each quadrant, as a check.

(2) *Procedure for declinating the aiming circle at a declination station.* Where a declination station is available, the procedure for declinating the aiming circle is as follows:

(*a*) Set up the aiming circle over the declination station. Level the instrument and perform the checks as outlined in *e.* above. Use the plumb bob to make sure the instrument is over the station.

(*b*) Set the known grid direction to the azimuth mark on the instrument using the azimuth micrometer knob (recording motion).

(*c*) Look through the panoramic sight (elbow telescope) and, using the orienting knobs (nonrecording), place the vertical crossline on the left edge of the azimuth mark. The aiming circle is now oriented on grid north.

(*d*) With the recording motion, rotate the instrument to zero. Release the magnetic needle. Look through the magnifier in the side of the main housing of the aiming circle and using the azimuth micrometer knob, center the south end of the needle in the middle of the etched marks.

(*e*) Read the declination constant directly from the azimuth scales. (Determine to the nearest 0.5 mils.) Relock the needle.

(*f*) Using the procedure outlined in (*b*) through (*c*) above, determine the declination constant to the remainder of the azimuth mark(s).

(*g*) Compare the declination constants to all azimuth marks. If they agree within 2 mils, determine the mean and record it to the nearest 1 mil on the notation strip on the aiming circle; if they vary more that 2 mils, repeat the entire procedure. If the declination constants to each of the azimuth marks still do not agree within 2 mils, after repeating the process, there is something wrong with the instrument or the declination station.

(3) *Procedure for declinating an aiming circle when a declination station is not available.* This procedure is the least desirable and should be used only when no other means are available; it does not compensate for the error which may be inherent in the aiming circle.

(*a*) Determine the GM angle from the map of the area in which the aiming circle is to be used. This GM angle is used as indicated below.

(*b*) In 1, figure 20 the difference between grid north and magnetic north in a *clockwise direction* is 6200 mils. This can be used as the declination constant.

(*c*) In 2, figure 20 the difference between grid north and magnetic north in a *clockwise direction* is 120 mils. This can be used as the declination constant.

h. Orienting Instrument, on Grid North to Measure Grid Azimuth to Objects.

(1) Level the instrument.

(2) Set the azimuth micrometer and the azimuth scale on the declination constant of the instrument.

(3) Release the magnetic needle.

(4) With the orienting knob, aline the south end of the needle accurately with the center etched line by using the magnetic needle magnifier.

(5) Lock the magnetic needle and close the orienting knob covers.

(6) Using the throwout mechanism (azimuth knob), turn the telescope until the vertical line of the reticle is approximately on the object.

(7) By rotating the azimuth knob, bring the vertical line exactly on the object.

(8) Read the azimuth to the object on the azimuth and micrometer scales.

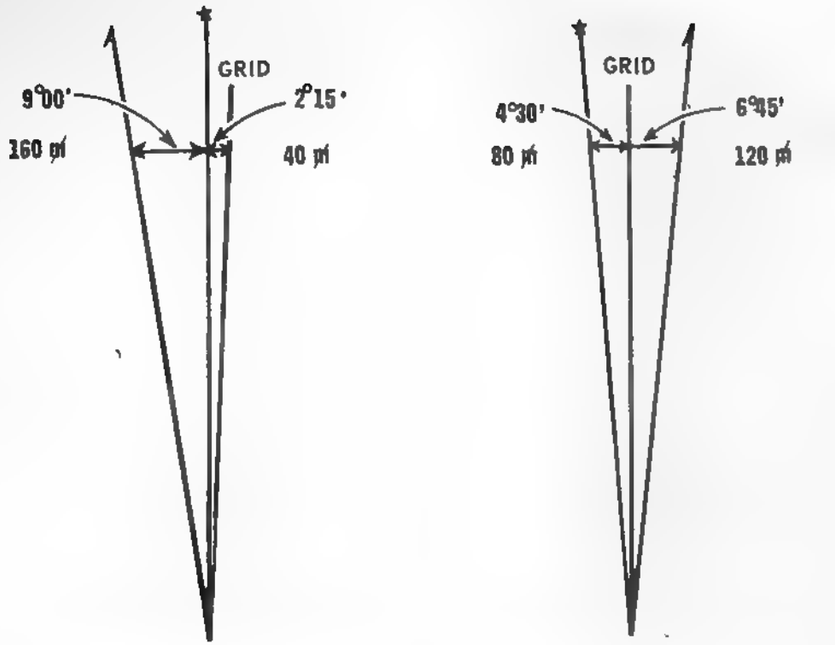
i. Measuring the horizontal angle between two points. (At least two measurements should be made.)

(1) Set the azimuth micrometer and the azimuth scale at zero.

(2) Rotate the instrument using the orienting knob throwout mechanism until the vertical line of the telescope is approximately on the left edge of the left-hand object.

(3) Lay the vertical line exactly on the right edge of the left-hand object by rotating the orienting knob.

(4) Using the throwout mechanism (azimuth knob), turn the telescope clockwise until



DECLINATION DIAGRAM FOR LOCALITY WHERE INSTRUMENT IS TO BE DECLINATED.

1

DECLINATION DIAGRAM FOR LOCALITY WHERE INSTRUMENT IS TO BE USED.

2

Figure 20. Marginal data from a map.

the vertical line is approximately on the left edge of the right-hand object.

(5) Lay the vertical line exactly on the left edge of the right-hand object by turning the azimuth knob.

(6) Read the horizontal angle on the scales and record the value to the nearest 0.5 mil. (This completes the first repetition.)

(7) Rotate the aiming circle, using the lower motion, until the vertical crossline is again on the rear station. (The value obtained from the first repetition is still on the scales.)

(8) Rotate the aiming circle body, using the upper motion, until the vertical crossline is again on the forward station.

(9) Read and record the accumulated value of the two measurements of the angle to the nearest 0.5 mil. (This completes the second repetition.)

(10) Divide the second reading by 2 to obtain the mean angle to the nearest 0.1 mil. This mean angle must be within 0.5 mil of the first reading; if it is not, the measurement is void and the angle is remeasured.

j. Measuring Vertical Angles.

(1) Turn the elevation knob until the crosslines are centered on the required point. Read the angle of elevation or depression from the elevation and micrometer scales.

(2) Small horizontal and vertical angles (up to 170 mils) can be measured by using the aiming circle reticle. This method is applicable to mean point of impact registration observation. (See FM 23–91, Mortar Gunnery.)

k. Orienting the 0–3200 Line of the Aiming Circle on a Given Grid Azimuth. The following illustrates the procedure of orienting the 0–3200 line of the aiming circle on a given grid azimuth. In this example the mounting azimuth is 5550 mils and the aiming circle is assumed to have a declination constant of 6380 mils.

(1) Set up and level the aiming circle as in *e.* above.

(2) Subtract the announced mounting azimuth from the declination constant of the aiming circle (adding 6400 to the declination constant of the aiming circle if the mounting azimuth is larger). In this case, subtract the mounting azimuth 5550 from declination constant 6380.

Solution:

Declination constant	6380 mils
Announced mounting azimuth	5550 mils
Remainder	830 mils

(3) Set the remainder on the azimuth and micrometer scales of the aiming circle. In this case, the remainder is 830 mils (recording motion).

(4) Release the compass needle. Look through the window in the cover housing and rotate the instrument until the needle floats freely using the orienting knob throw-out mechanism. For fine adjustments, use orienting knobs until the magnetic needle is exactly centered on the etched marks on the magnifier. Relock the compass needle. This orients the 0–3200 line of the aiming circle on the mounting azimuth; in this case, grid azimuth of 5550 mils (fig 21).

(5) Once the aiming circle is oriented, do not disturb the *lower motion* of the aiming circle.

l. Orienting the 0–3200 Line of the Aiming Circle on a Given Magnetic Azimuth.

(1) Subtract the announced magnetic azimuth from 6400.

(2) Set the remainder on the azimuth and micrometer scales of the aiming circle.

(3) Release the compass needle and rotate the orienting knob until the magnetic needle is exactly centered in the magnetic needle magnifier. Lock the compass needle.

(4) The 0–3200 line of the aiming circle is now oriented on a given magnetic azimuth.

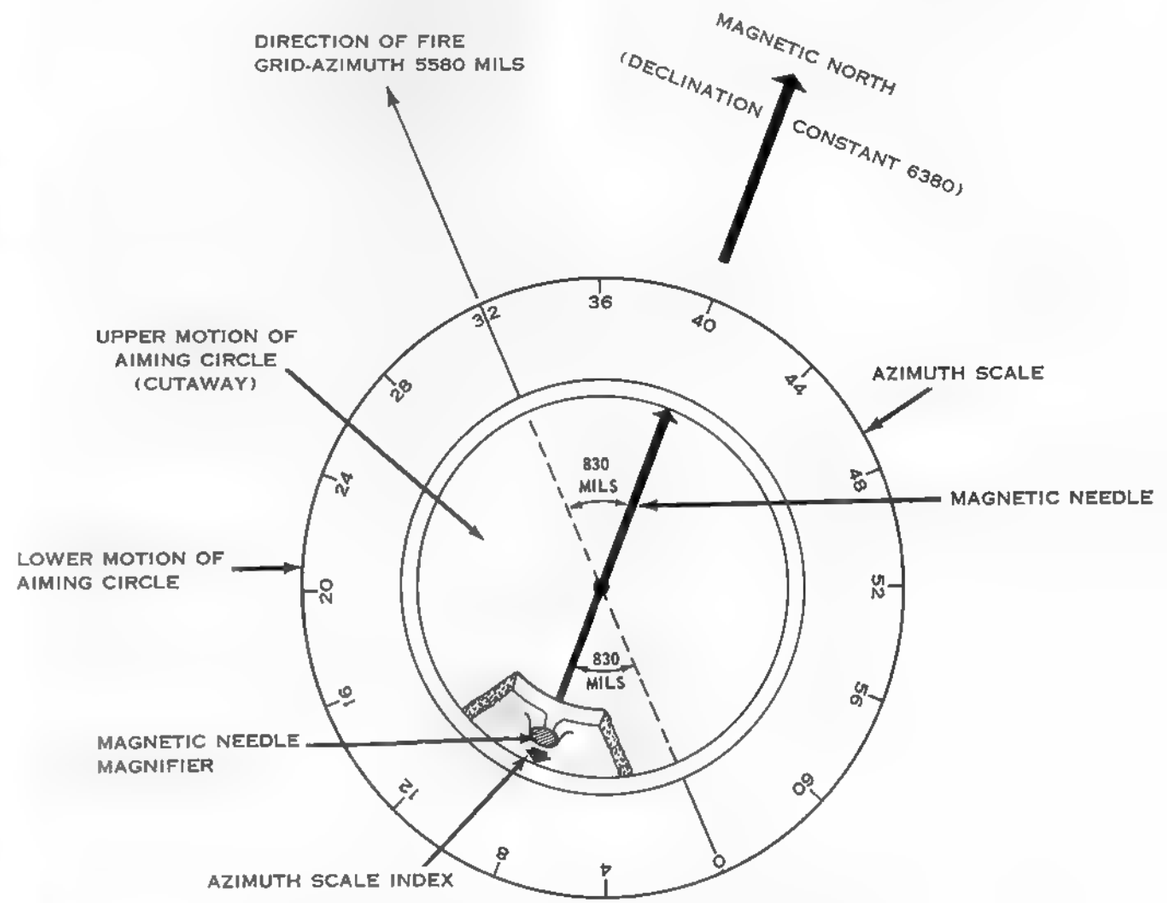


Figure 21. Aiming circle oriented in desired direction of fire.

m. Orienting by Orienting Angle. This method eliminates magnetic errors resulting from the use of the magnetic needle of the aiming circle.

(1) An *orienting angle* is the horizontal clockwise angle from the mounting azimuth to the orienting line, the vertex being at the orienting station.

(2) An *orienting angle* is a line of known direction established on the ground near the firing section which serves as a basis for laying for direction. This line is established by a survey team.

(3) The instrument operator sets the aiming circle over the orienting station and levels, as outlined in *e* above. He places the orienting angle on the azimuth scale. He then sights on the far end of the orienting line, using the lower motion. The magnetic needle is not used to orient the aiming circle. This eliminates any magnetic error that may exist in the instrument. Close the orienting knob cover.

(4) The 0–3200 line of the aiming circle is now oriented parallel to the mounting azimuth. Example azimuth of orienting line is 3200 mils. The azimuth on which the section leader wishes to lay the section is 1600 mils. The orienting angle is *1600* mils (fig 22).

Azimuth of orienting line	3200 mils
Minus mounting azimuth	1600 mils
Orienting angle	1600 mils

The aiming circle is set up over the orienting station. (Use plumb bob.) The upper motion is used to set off 1600 mils on the aiming circle. The section leader sights on the end of the orienting line using the lower motion. The 0–3200 line of the aiming circle is now oriented.

n. Taking Down the Aiming Circle. Instructions for taking down the aiming circle are located inside the circle cover.

o. Care and Maintenance of Aiming Circle, M2. The aiming circle will not stand rough handling or abuse. Proper care will prolong its life and insure better results to the user. Inaccuracies or malfunctions will result from mistreatment.

(1) *Care.* Observe the following precautions:

(*a*) Stops are provided on instruments to limit the travel of the moving parts. Do not attempt to force the rotation of any knob beyond its stop limit.

(*b*) Keep instrument as clean and dry as possible. If the aiming circle is wet, dry it carefully.

(*c*) When not in use, keep the equipment covered and protected from dust and moisture.

(*d*) Do not point the telescope directly at the sun unless a filter is used, as the heat of the focused rays may damage optical elements.

(*e*) Keep all exposed surfaces clean and dry to prevent corrosion and/or etching of the optical elements.

(*f*) To prevent excessive wear of threads and other damage to the instrument, do not tighten leveling, adjusting, and clamping screws beyond a snug contact.

(*g*) The aiming circle should not be lubricated by unit personnel.

(2) *Maintenance.* Whenever inaccuracies, maladjustment, or any other conditions affecting serviceability are disclosed by the inspection prescribed in paragraph 28, the necessary corrective action should be taken if the maintenance required is within the scope of the using organization. If not, the aiming circle should be returned to ordnance maintenance personnel. Maintenance procedures can be determined from TM 9–6166.

p. Checklist for Inspection of the M2 Aiming Circle.

(1) Azimuth and orienting knobs.	Traverse instrument 6400 mils without binding or sticking.
(2) Leveling screws	Turn freely, but with enough friction to permit and maintain accurate positioning.
(3) Elevation knob	Elevate and depress telescope throughout full travel without binding or sticking.
(4) Level vials	Firm in their settings. Covers move freely.
(5) Scales and micrometers	Graduations legible. Simultaneous zero readings obtained on corresponding scales and micrometers.
(6) Compass needle	Locks and unlocks readily. Swings freely when unlocked and reacts to magnetic north properly.
(7) Optical elements	Free from cracks, moisture, frost patterns, and dirt. Sharp clear image.
(8) Instrument light	Lights operate, reticle light illumination increases and decreases in response to turning rheostat knob, machined dovetail undamaged on reticle light, and battery case undamaged.
(9) Tripod	Telescoping legs and clamps work properly head screw operates freely and will secure the head to the tripod, machined upper surface undamaged and cover for the machined surface in good condition.

38. When to Declinate the Aiming Circle.

Certain rules prescribe how often and under what circumstances the aiming circle should be declinated in order to determine and keep the declination constant current. These rules are as follows:

a. As a general rule, the aiming circle should be redeclinated when it is moved 25 miles or more from the area in which it was last declinated. A move of any appreciable distance (a few miles) may change the relationship of grid north and magnetic north as measured by the instrument. In some locations, a move of less than 25 miles may require redeclination of the aiming circle.

b. The aiming circle must be redeclinated after an electrical storm or after receiving a severe shock, such as a drop from the bed of a truck to the ground. The magnetic needle is a delicately balanced mechanism, and any shock may cause a significant change in the declination constant for the instrument.

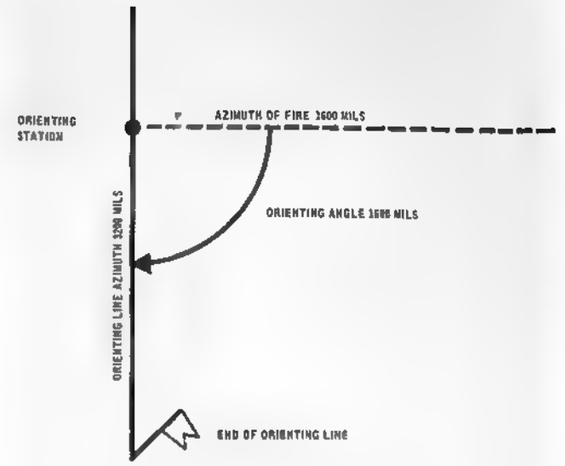


Figure 22. Orienting by orienting angle.

c. The aiming circle should be redeclinated every 30 days to guard against changes which may have occurred due to accidents to the instrument which were not reported. If a radical change is observed, the instrument should be redeclinated again within a few days to determine if the observed change was due to a magnetic storm or is a real change in the characteristics of the instrument.

d. The aiming circle should be redeclinated when it is initially received and redeclinated when it is returned from support maintenance repair. Variations in the declination constant due to the time of day are not significant enough to warrant a redeclination at any specific time.

Section IV. MAINTENANCE

39. General.

This section contains instructions for operator and organizational maintenance of the 81-mm mortar, M29A1; 81-mm mortar mount, M23A1; 81-mm mount, M23A3; and sight units M34 and M53. In all cases where the nature of repair, modification, or adjustment is beyond the scope or facilities of the unit, the responsible maintenance support will be informed so that trained personnel with suitable tools and equipment may be provided or proper instructions issued.

40. Forms, Records, and Reports

a. General. Responsibility for the proper preparation of forms, records, and reports rests upon the officers of all units maintaining this equipment. However, the value of accurate records must be fully appreciated by all persons responsible for compilation, maintenance, and use. Records, reports, and authorized forms are normally utilized to indicate the type, quantity, and condition of material to be inspected, repaired, or used in repair. Properly prepared forms convey authorization and serve as records for repair or replacement of materiel in the hands of troops and for delivery of materiel requiring further repair to supporting maintenance activity. The forms, records, and reports establish the work required, the progress of the work within the shops, and the status of the materiel upon completion of its repair.

b. Authorized Forms. For a listing of all forms, and instructions on use of these forms, refer to TM 38–750.

c. Field Report of Accidents.

(1) *Injury to Personnel or Damage to Materiel.* The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in AR 385–10. These reports are required whenever accidents involving injury to personnel or damage to materiel occur.

(2) *Ammunition.* Whenever an accident or malfunction involving the use of ammunition occurs, firing of the lot which malfunctions will be immediately discontinued. In addition to any applicable reports required in (1) above, details of the accident or malfunction will be reported as prescribed in AR 75–1.

d. Report of Unsatisfactory Equipment and Materiel. Any deficiencies detected in the equipment covered herein which occur under the circumstances indicated in AR 700–38 should be immediately reported in accordance with the applicable instructions in those regulations.

e. Destruction of Material. Reference TM 9–1015–200–12, for details.

41. Special Tools and Equipment

a. Tools and equipment are issued to the using organization for maintenance. These tools and equipment should not be used for purposes other than those prescribed and, when not in use, should be properly stored. Repair parts are supplied to the using organization for replacement of those parts most likely to become worn, broken, or otherwise unserviceable, when such operations are within the scope of organizational maintenance function.

b. Certain tools and equipment specially designed for organizational maintenance, repair, and general use with the materiel are listed in table 2 for information only. This listing is not to be used for requisitioning replacements.

42. Painting

a. Only the baseplate is painted. Camouflage painting information is contained in FM 5–20.

b. Do not paint over namèplates, serial numbers, inner ring socket cap, mortar seat in inner ring, or working surfaces which are lubricated in accordance with the lubrication chart. Nameplates will be kept coated with clear lacquer; if they have become rusty or corroded, they will first be carefully cleaned.

c. Complete painting of sighting and fire control equipment by the using organization is not permitted. Scratched or chipped surfaces should be retouched to prevent corrosion.

Table 2. Special Tools and Equipment for Organizational Maintenance

Item	Identifying No.	Use
BRUSH, cleaning, chamber, M6 FSN 1005–610–8828	6108828	To clean firing pin recess.
WRENCH, fuze, M18 FSN 4933–723–1161	7231161	To tighten the fuze to the projectile.
COVER, muzzle FSN 1015–723–7701	7237701	To cover muzzle of mortar when not in use.
KEY, socket head screw FSN 5120–240–5274	41–W–2455	To remove or install the firing pin.
PAD, shoulder, M3 FSN 1010–656–9375	6569375	To support the weapon when carried.
STAFF, cleaning, M8 FSN 1015–557–0617	5570617	To clean mortar bore.
WRENCH, strap FSN 5120–262–8491	96906–16183–2	To hold cartridge when removing fuze.

43. Basic Preventive Maintenance

a. Inspect and service the weapon as prescribed by the applicable technical manual.

b. Rust, dirt, grit, gummed oil, and water cause rapid deterioration of all parts of the weapon. Particular care should be taken to keep all bearing surfaces and exposed unpainted parts cleaned and properly lubricated. Wiping cloths, rifle-bore cleaner, mineral spirits, paint thinner, and lubricants are furnished for this purpose. Remove all traces of rust from finished surface with crocus cloth, which is the coarsest abrasive to be used by organizational personnel. A coarser abrasive may be used on unfinished parts. Take care not to change the shape or dimensions of part.

c. Repaint painted surfaces as required to cover nicks, scratches, and worn spots which expose bare metal. Complete repainting is not necessary.

d. Tighten loose parts, as necessary.

e. Each time a weapon is disassembled for cleaning or repair, carefully inspect all parts for cracks, excessive wear, rust, and like defects which might cause malfunctions of the mortar. A periodic inspection of the baseplate should be conducted to check for bent or broken ribs. Thoroughly clean and properly lubricate all parts before assembly.

f. At least once every 6 months, check to see that all modification work orders have been applied. A list of current modification work orders is published in DA Pam 310–7. No alteration or modification will be made by organizational personnel, except as authorized by official publications.

g. Use only tools that are provided and see that they fit properly. Tools that do not fit may cause damage to parts.

h. When the mortar is not in use, install the proper covers.

i. When a canvas or other type cover is used during periods of inactivity, moisture may form on metal surfaces by condensation. To prevent rusting, remove the covers at least weekly and dry all surfaces. Apply the prescribed lubricants. In cold weather, apply lubricant sparingly.

j. It is necessary to exercise the mortar frequently. This means working and operating all moving parts without actually firing the mortar. In moderate climates, the mortar should be exercised at least once a week.

k. Promptly report unsatisfactory performances to the supporting maintenance activity if correction is beyond the scope of organizational maintenance.

44. Preventive Maintenance by Operator(s)

Purpose. To assure maximum operational readiness, the equipment must be systematically inspected at intervals every day it is operated, to discover and correct defects before they result in serious damage or failure. Certain scheduled maintenance services will be performed at these designated intervals. Any deficiencies discovered that cannot be corrected by the operator, or corrected by replacing parts, will be reported on DA Form 2404 (Equipment Inspection and Maintenance Worksheet).

45. Specific Procedures for Organization Maintenance

Table 3 gives the specific procedures to be followed by the operator for each daily service of the equipment.

a. Muzzle Cover. To prevent formation of mildew, shake out and air the canvas cover for several hours at frequent intervals. Have any loose gromments or rips in the canvas repaired without delay. Failure to make immediate repairs may allow a minor defect to develop into major damage. Mildewed canvas is best cleaned by scrubbing with a dry brush. If water is necessary to remove dirt, it must not be used until mildew has been removed. If mildew is present, examine fabric carefully for evidence of rotting or weakening of fabric by stretching and pulling. If fabric shows evidence of loss of tensile strength, it is probably not worth re-treatment. If not damaged, notify organizational maintenance personnel so that steps can be taken to have canvas re-treated. Oil and grease can be removed by scrubbing with issue soap and warm water. Rinse well with clear water and dry.

b. Mortar Barrel Assembly. Maintenance of the mortar barrel assembly consists chiefly of cleaning and inspecting for dented barrel or broken or worn firing pin. The mount attachment ring should be located between two white or aluminum color graduation marks which should be located 17 and 21 inches from the muzzle. The marks should be in the same place as one of the two flats on the base cap plug. If the marks are not at these locations, clean and dry the threads at these locations and then paint marks 1 1/2 inches long on the crest of the threads; then scratch off any incorrectly located marks. Position the mount attachment ring between, not overlapping, the marks, and check this location when mounting the mortar for firing. (This will prevent the yoke body from butting against the end of the full-diameter thread, which might cause dislodging of the bronze ring in the yoke during firing.)

c. Bipod Assembly (M23A1, M23A3).

(1) *Check the Functioning of the locking sleeve and sliding bracket.* The locking sleeve is located on the bipod left leg. Turning the sleeve clockwise releases the sliding bracket and permits it to be moved along the bipod leg. The sliding bracket is located on the bipod left leg. With the sleeve turned clockwise, the bracket is moved on the leg until the bubble in the crosslevel of the sight indicates approximately level; the sleeve is then turned counterclockwise to lock the sliding bracket on the leg. This operation provides the coarse adjustment in the crossleveling of the mortar. The sliding bracket must grip firmly at any point of its travel on the bipod leg when the locking sleeve is tightened.

(2) *Check the functioning of the adjusting nut.* The adjusting nut is located on the bipod left leg. With the mount crossleveled roughly ((1) above), precise, final crossleveling is accomplished by rotating the adjusting nut in the direc-

Table 8. Preventive Maintenance Checks and Services

Interval and sequence No.			Items to be inspected	Procedures
Before firing	During firing	After firing		
1			Muzzle cover	Check for loose buckles, rips or mildew.
2		7	Mortar barrel assembly	Clean and inspect for cracks, dents, or bulges. Remove firing pin and inspect for cracks or wear.
3			Bipod assembly	Check traversing and elevating mechanism for smoothness of operation throughout entire range. Test functioning of the shock absorber and locking pin.
4			Baseplate assembly M23A1	Check socket for rotation and baseplate latches (if any) for locking action.
			Baseplate assembly M3	Check socket cap to insure free rotation.
	6		Mortar and bipod assembly	While mount is in operation, the crew should be alert for any unusual sounds which could be a sign of trouble.
5			Sighting and fire control instruments	Clean optical surfaces & inspect for cracks, chips, presence of fungus or other undesirable conditions. Test lighting devices. (If any of the above conditions are present, notify supporting maintenance.)

tion and amount necessary to center the bubble in the level. Only when the mortar is exactly cross-leveled can the elevating and traversing operations be performed independently without affecting each other. The adjusting nut must precisely control the crosslevel and must have a minimum of looseness or play on the left leg body.

(3) *Check the functioning of the elevating mechanism.* To check the elevating mechanism, rotate clockwise the elevating handwheel crank until maximum elevation is reached, then rotate counterclockwise until minimum elevation is reached. Operation of the elevating mechanism in both motions, up and down, should be smooth. If elevating mechanism has been completely immersed in water, notify supporting maintenance personnel.

(4) *Check the functioning of the traversing mechanism.* The traversing handwheel assembly, located on the right side of the traversing mechanism, is used for traverse adjustments. Turning the wheel assembly clockwise traverses the mortar to the left; counterclockwise rotation traverses it to the right. The traversing spindle must operate smoothly over its entire range in both directions. If traversing mechanism has been completely immersed in water, notify supporting maintenance personnel.

(5) *Disconnect shock absorber clevis lockpin.* Pull shock absorber clevis out; it should return to normal position with air blowing out through tiny holes in upper end of shock absorber. If shock absorber has been completely immersed in water, notify supporting maintenance personnel.

d. Baseplate M23A1.

(1) The baseplate is a two-piece unit and, when assembled for use, the inner ring assembly and outer ring assembly are secured together by three outer ring latches fastened to the top of the baseplate outer ring by three latch clamping screws. Each latch has an outer ring latch clamping screw to clamp it in position. The outer ring has latch stops welded in locations which permit the latches to be swung approximately 90° from latched to unlatched position.

(2) To assemble the inner and outer ring assemblies of the baseplate, unscrew the outer ring latch clamping screws until completely loose in the latches and swing the latches to the unlatched position, then put the baseplate inner ring assembly into the outer ring assembly. With the faces of the inner and outer rings flush, swing the latches to the latched position, and lock by tightening the latch clamping screws.

(3) The inner ring socket cap of the baseplate is retained in the inner ring by the inner ring socket cap collar, but rotates freely.

e. Baseplate M3. The baseplate is a one-piece unit made of an aluminum alloy. The socket cap should rotate freely 6400 mils.

f. Optical Parts. Keep the exposed surfaces of lenses and other parts clean, dry, and free from oil and grease to prevent corrosion and etching of the surface of the glass. Do not touch the lenses or windows with bare hands. To remove oil or grease from optical surfaces, use a tuft of tissue lens paper. If immersed in water, notify supporting maintenance personnel.

46. General Lubrication Instructions

a. Usual Conditions. Service intervals specified on the lubrication chart are for normal operation and where moderate temperature, humidity, and atmospheric conditions prevail. Under normal conditions all unpainted surfaces and all bearing surfaces of moving parts will be lightly lubricated. This is best accomplished by wiping with a clean, lintless cloth saturated with the lubricant and wrung out. Oil internal parts of the elevating and traversing mechanisms.

b. Unusual Conditions. Reduce service intervals specified on the lubrication order to compensate for abnormal operation and extreme conditions, such as high or low temperatures, prolonged periods of operation, continued operation in sand or dust, immersion in water, or exposure to moisture. Any one of these operations or conditions may quickly destroy the protective qualities of the lubricant. For complete detailed instruction see TM 9–1015–200–12.

47. Preventive Maintenance by Organizational Mechanic

a. Preventive maintenance is the systematic care, inspection, and servicing of equipment to maintain it in serviceable condition, prevent breakdowns, and assure maximum operational readiness. Second echelon preventive maintenance is accomplished by the organizational mechanics. Their role in the performance of preventive maintenance services is:

(1) To perform the monthly scheduled periodic services specified by pertinent technical manuals.

(2) To lubricate the equipment in accordance with the lubrication chart.

b. TM 9–1015–200–12 prescribes and describes the monthly inspections, tests, and adjustments that must be made in the performance of second echelon preventive maintenance.

48. Daily Care and Cleaning

Mortar material in the hands of troops is inspected daily. Training schedules should allow time for supervised cleaning on each day this material is used.

a. Maintain a film of preservative lubricating oil (PL special or PL medium on all unpainted metal parts of the mortar and basic issue items. Use a cleaning rod and waste to oil the bore. Oil all other unpainted surfaces with an oily cloth. Keep all surfaces clean and free from rust.

b. To prevent dryness, mold, or mildew on the muzzle cover, clean it with saddle soap and apply neat's-foot oil.

c. To clean the canvas items, wash them with a mild soap and dry in the shade.

49. Before and During Firing

a. Before firing, inspect the mortar. Dry the bore before firing and between missions. Swab the bore with clean, dry waste; be careful not to leave any waste on the firing pin or cleaning liquid in the bore. Thoroughly clean and oil (lightly) all metal moving parts with lubricating oil, general purpose.

b. During firing, the bore should be swabbed after each 10 rounds fired or after each fire mission.

50. After Firing

a. Immediately after firing, preferably while the barrel is still warm, and for 2 consecutive days thereafter (or as long as the barrel continues to sweat), swab the bore with cleaning compound, solvent (rifle bore cleaner(CR)) until all fouling is removed. When rifle bore cleaner is not available use a soap solution or plain water. Dry and oil the bore to prevent rust.

b. Remove the firing pin before cleaning the bore. Insert the firing pin vent cleaning brush into the vent, turning the brush in a clockwise direction to remove any excess foreign material from the shoulders of the vent. Clean this area carefully because the firing pin will not seat correctly when there is any foreign material left on the shoulders, and this causes gas leakage. After cleaning the exterior, oil the exterior, vent, and the firing pin and replace the firing pin by screwing it tightly into the baseplug, using a standard length hex wrench. Replace firing pins found to be eroded or broken.

c. In cleaning the mount, take care to remove dirt from all crevices. Clean all moving parts with drycleaning solvent, dry them, then apply lubricating oil to the three flush-type lubricating fittings. The fittings are located on the connecting rod bracket, the gear case, and the yoke. Be sure

and operate the traversing handwheel and elevating crank to distribute oil over the working surfaces.

d. After each firing mission, and whenever socket does not rotate easily in baseplate (particularly possible in sandy soil), remove the retaining ring by squeezing the tangs together. (Use pliers or other suitable tool a pair of empty cartridges cases slipped over the tangs can be used.) Remove socket and four cushions below it. Wipe all dirt, lubricants, etc. from cushions, rings, socket and baseplate socket seat. If cushions are colored brown, apply a liberal coating of GAA grease (spec MIL–G–10924) to them. (If cushions are black, they should be replaced by combination of adopted items (FSN 1015–247–7177, Dwg. 11578336), which consists of the four brown cushions.) Reassemble the parts, be sure the socket is firmly seated and the retaining ring is properly secured.

e. Inspect, clean, and oil the accessories.

CHAPTER 2

CREW DRILL

Section I. GENERAL

51. Purpose

a. The platoon leader commands the platoon and supervises the training of all elements. He makes full use of the chain of command to assist him in carrying out these responsibilities.

b. The platoon leader employs crew drill to achieve proficiency and teamwork in the mortar section. Crew drill is concerned with training each mortar squad individually and the mortar section collectively.

c. Crew drill for the mortar squad is divided into two training phases: squad training, where each squad member receives instructions on his individual duties and responsibilities within the squad; and squad drill, where each squad member performs his duties during a practical exercise.

d. Crew drill for the mortar section is also divided into two training phases: section training, where the mortar squads receive instruction on their duties and actions as individual members of the mortar section; and section drill, where the mortar squads participate in a practical exercise demonstrating what they have learned in squad training, squad drill, and section training.

52. Application

If the mortar section is to operate quickly and effectively in accomplishing its mission, each mortar squad member must be proficient in his individually assigned duties. By correctly applying and performing these duties as a team member, he enables the mortar squad and section to perform as effective fighting teams. Successful application of crew drill develops the proficiency and teamwork required for the mortar section to complete its assigned mission.

Section II. SQUAD TRAINING

53. Positions and Duties

The mortar squad consists of five men (fig 23). Their firing positions and principal duties are as follows:

a. The squad leader is behind the mortar where he can command and control his squad. In addition to supervising the emplacement, laying, and firing of the mortar, he supervises all other squad activities.

b. The gunner is on the left side of the mortar where he can manipulate the sight and the elevating gear handle and traversing assembly wheel. He places firing data on the sight and lays the mortar for deflection and elevation. He and the assistant gunner make large deflection shifts by shifting the bipod assembly.

c. The assistant gunner is on the right of the mortar, facing the barrel and ready to load. In addition to loading, he is responsible for swabbing the bore after each 10 rounds have been fired, or after each fire mission. He assists the gunner in shifting the mortar when making large deflection changes.

d. The first ammunition handler is to the right rear of the mortar and has the duty of preparing the ammunition and passing it to the assistant gunner.

e. The second ammunition handler is normally behind the mortar, maintaining the ammunition for firing, providing local security for the mortar position, filling sandbags, and performing other duties as the squad leader directs. The second ammunition handler will normally be the member who places out and retrieves the aiming post.

f. The second ammunition handler is also the squad truck driver. When his duties do not re-

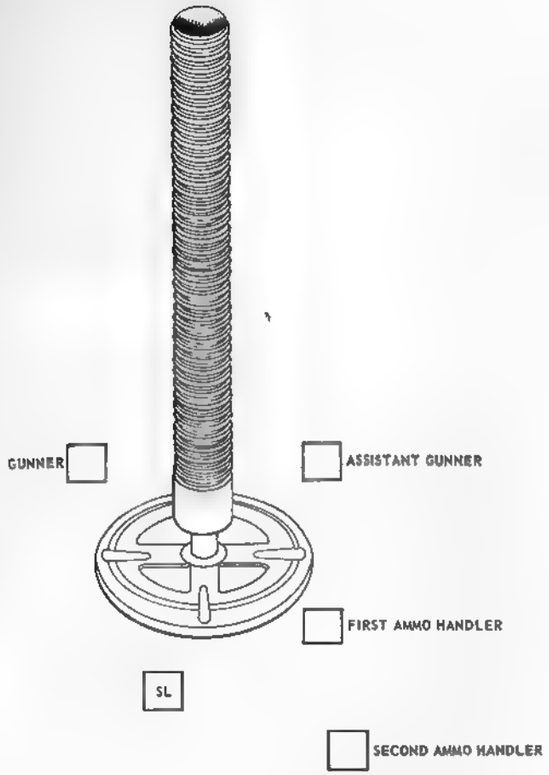


Figure 23. Position of squad members.

quire him to be with the vehicle, he is used as an ammunition handler (performing the same type duties as the first ammunition handler).

54. Sight Setting

Firing data (deflection and elevation) are received from the fire direction center (FDC) in the form of fire commands (para 85). The deflection element of the fire command is always announced before elevation. The gunner places the deflection on the sight as soon as it is announced. He turns the deflection knob until the correct 100-mil mark on the coarse deflection slip scale (deflection scale on the M34A2 sight unit) appears above one deflection scale index. He continues to turn the deflection knob until the remainder of the deflection reading appears opposite the deflection micrometer index. When the elevation element of the fire command is announced, the gunner immediately places this on the sight. He turns the elevation micrometer knob until the correct 100-mil elevation mark appears opposite the elevation scale index. He continues to turn the elevation micrometer knob until the remainder of the elevation reading appears opposite the elevation micrometer index.

55. Laying the Mortar for Elevation

After placing the correct elevation on the sight, the gunner turns the elevating gear handle to elevate or depress the mortar until the bubble in the elevation level vial is centered. This lays the mortar correctly for elevation.

56. Use of Aiming Line

a. Two aiming posts are provided to establish an aiming (or reference) line. These posts are placed on a line from the mortar position in a convenient direction. The far aiming post is placed out approximately 100 meters. The near post is placed approximately 50 meters away. (In all cases, the near aiming post must be approximately halfway between the mortar and the far aiming post). The use of two aiming posts reduces the error caused by large deflection shifts or displacement of the baseplate assembly during firing.

b. When the mortar is laid for deflection, the gunner sees the alined sight picture shown in figure 24. The vertical line of the sight is laid on the left edge of the near post, the far post being obscured by the near post. The two posts appear as one. If they do not appear as one, displacement of the sight has occurred and is compensated for as discussed in paragraph 62.

c. Once the aiming line is established, the gunner should refer his sight to some clearly defined object as close to his aiming line as possible. He should record the difference (in mils) between this object and the aiming line. This establishes the auxiliary aiming point which can be used if something should happen to the aiming posts. If it is necessary to use the auxiliary aiming point, the mil value of the difference of the two aiming lines should be applied to the deflection received from the FDC.

d. When an object other than the aiming posts is used as an aiming point, place the vertical line of the sight on some clearly defined point on that object. When no clearly defined point exists on the object, use the left edge of the object as the aiming point.

57. Laying the Mortar for Deflection

a. Since the FDC knows the deflection on which the aiming posts are placed, it is able to give the mortar crew the deflection to a target as an angle of shift from the aiming posts. The fire command from the FDC contains the exact deflection to be placed on the sight to shift the mortar to the desired direction. When a new deflection is placed on the sight, the vertical crossline will shift away from the aiming posts. The gunner then turns the traversing crank to realine the vertical line. The gunner turns the elevating crank (left or right, whichever is appropriate) and levels the elevation bubble. He next turns the traversing handwheel and the adjusting nut (forward or rearward, whichever is appropriate) and traverses onto the aiming post, making sure the crosslevel remains level during this process.

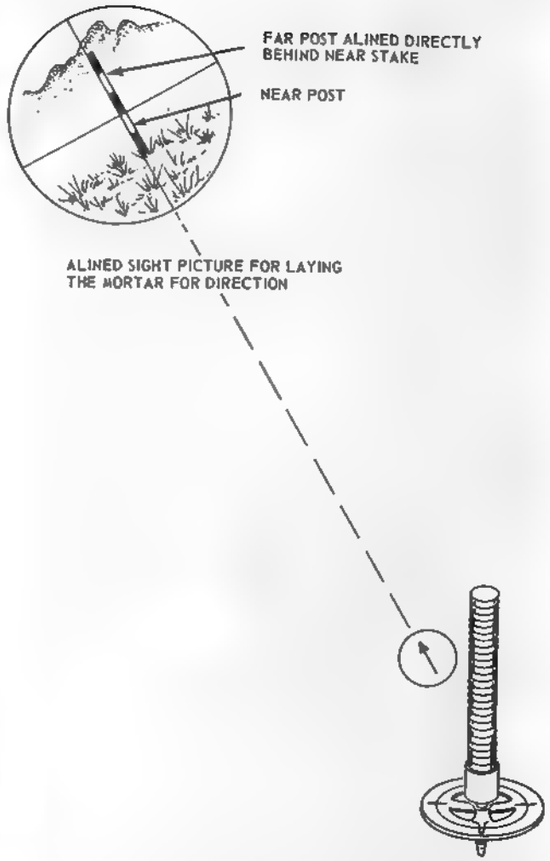


Figure 24. Alined sight picture.

Note. The traversing handwheel and the adjusting nut must be turned in the same direction in order to keep the bubble level during traversing of the mortar. One quarter turn of the adjusting nut is equal to one turn of the traversing handwheel. This lays the mortar correctly for deflection.

b. It is possible to traverse the mortar 95 mils to the right or left of center without moving the bipod assembly; however, it is desirable to move the bipod assembly when a deflection shift of more than 75 mils from the center is made. This prevents unnecessary cant of the mortar and tends to make the mortar more stable. When movement of the bipod assembly is required, the assistant gunner moves to the front of the bipod assembly, facing it, lifts up on the bipod and the gunner moves the mortar onto the aiming post. The gunner then lays the mortar accurately on the aiming post by traversing.

58. Laying for Elevation and Deflection

a. To lay quickly for elevation and deflection on receiving the fire command, the gunner, keeping in mind the code word DEED—

(1) Places the announced deflection on the sight.

(2) Places the announced elevation on the sight.

(3) Operates the elevating gear handle to level for elevation.

(4) Looks through the sight and traverses the mortar to lay the vertical line on the aiming post, for deflection.

(5) Makes a final check of the elevation and crosslevel bubbles, and, when no further adjustment is needed, announces UP.

b. Exceptions to the above procedure occur if—A large deflection shift (more than 75 mils) requires the bipod assembly to be shifted. The gunner shifts the mortar approximately onto the aiming post, lays the mortar for elevation, crosslevels the sight, and makes final adjustment onto the aiming post.

59. Referring the Sight

Referring the sight means the gunner or the operator will manipulate the sight for a deflection change without manipulating the mortar in any way which will disturb the lay of the mortar. In mortar gunnery, referring the sight is normally used when establishing an aiming line or re-establishing a new aiming line. For example, the sight is referred to an initial deflection of 2800 mils to establish an aiming line on which to place out aiming posts (fig 25). To refer the sight, turn the deflection micrometer knob until a given deflection is set, or until the sight is laid on a given aiming point (for example, the sight is referred to an initial deflection of 2800 or the sight is laid on the auxiliary aiming point).

60. Placing Out Aiming Posts

a. When a firing position is occupied, it is necessary to determine in which direction the aiming posts are to be placed out. Factors which govern this selection are terrain, sight blockage, and the vehicular traffic pattern in the section area. If possible, the aiming posts should be placed out to the left front. This direction gives a large latitude in deflection change before sight bloackage occurs. Also, the aiming posts do not interfere with the traffic pattern of personnel and vehicles within the section area. Two aiming posts are positioned on a straight line to coincide with the line of sight of the M34A2 and M53 sight units. If the aiming posts are placed directly to the front, the line of sight is blocked by the barrel when the sight is turned approximately 0700 mils to the right. To compensate for this limitation, the aiming posts are normally placed out on a referred deflection (fig 25). To place out the aiming posts, look through the sight. By using arm-and-hand signals (fig 26), guide the second ammunition handler in placing a post approximately 100 meters from the mortar with the left edge of the post in line with the vertical crossline of the sight. Then direct him to place another post at half the distance between the far post and the mortar position. The two posts should appear as one.

Note. After the sight unit, M53, has been calibrated using the M45 boresight (para 30), slip the black coarse deflection scale and the black micrometer deflection so that they coincide numerically with the red deflection scales.

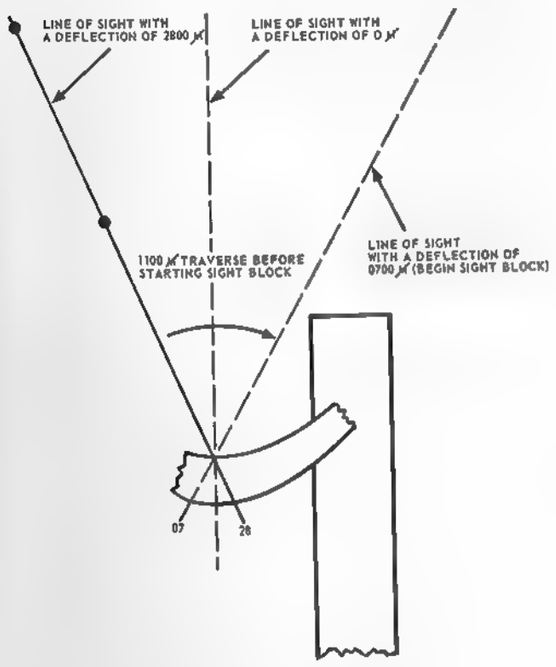


Figure 25. Referring the sight.

b. After the section sergeant has laid the section for direction, he will announce, SECTION DEFLECTION TWO EIGHT HUNDRED, REFER, PLACE OUT AIMING POSTS. The gunner refers his sight, without disturbing the lay of the weapon, to a referred deflection of 2800 mils, reading the black deflection scales. Once the sight is referred to 2800 mils, the gunner directs the second ammunition handler in placing out the aiming posts (fig 24).

c. In some situations, when the black deflection scales and the red deflection scales numerically coincide, local terrain features will not permit placing out the aiming posts at a referred deflection of 2800 mils. When this problem arises use the following procedure:

(1) Determine which general direction will enable you to properly place out your aiming posts, and still allow a maximum traverse before encountering a sight block.

(2) Refer the sight to that general direction and index any deflection to the nearest 100 mils.

(3) Place out the aiming posts.

(4) Slip the black coarse deflection scale to the referred deflection of 2800 mils.

(5) Record the deflection reading on the red deflection scales. It is important to record the deflection reading of the red deflection scales which corresponds to the referred deflection on the black deflection scales, so that if the black deflection scale is inadvertently moved, you can easily re-index the referred deflection on the black scale without having to re-lay the weapon.

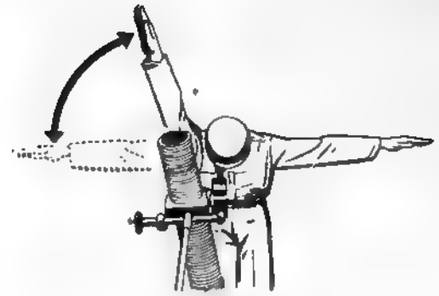
d. It is also necessary to slip the black deflection scales of the M53 sight when the mortar section is being employed in a 6400-mil capability.

(1) After the mortar is initially laid for direction, use the RED (fixed) deflection scale on the sight and place out the aiming posts on a referred deflection of 2800 mils.

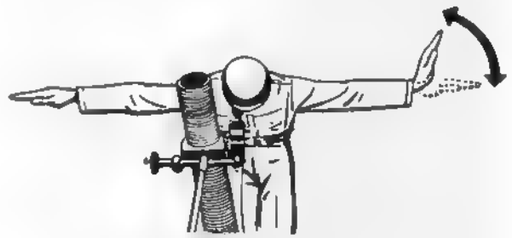
(2) Still using the RED (fixed) deflection scale, index a deflection of 6000 mils and place out two additional aiming posts, to the rear.

(3) With a deflection of 6000 mils indexed on the RED (fixed) deflection scale, slip the BLACK deflection scale so that the referred deflection of 2800 mils on the BLACK scale coincides to the deflection of 6000 mils on the RED scale. If it is not possible to place out the second set of aiming posts 3200 mils from the original set of aiming

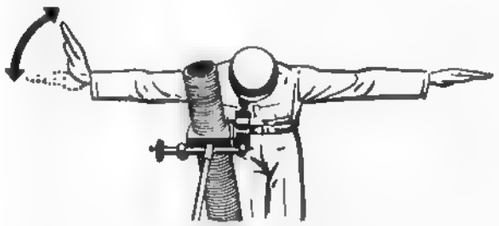
A. MOVE AIMING POST TO THE LEFT.



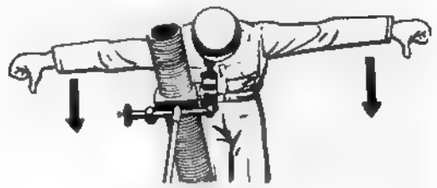
B. MOVE AIMING POST TO THE RIGHT.



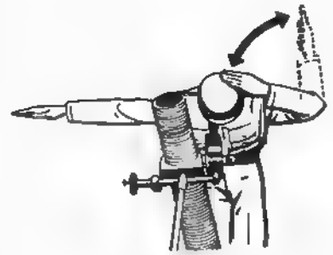
C. MINOR MOVEMENT OF THE POST TO THE LEFT.



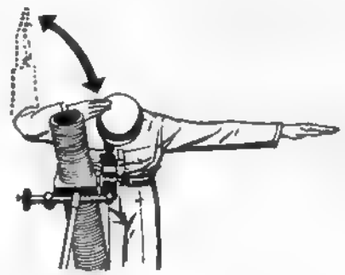
D. MINOR MOVEMENT OF THE POST TO THE RIGHT.



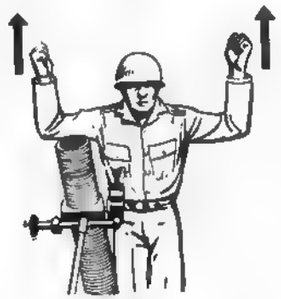
E. DRIVE IN POST



F. TILT POST TO THE LEFT.



G. TILT POST TO THE RIGHT.



H. POST CORRECT (MORTAR)

Figure 26. Arm-and-hand signals used in placing out aiming stakes.

posts because of obstacles, use the following procedure:

(*a*) Determine which general direction will enable you to properly place out the aiming posts. This direction should be to the rear of the mortar.

(*b*) Refer the sight to that general direction and index any deflection to the nearest 100 mils.

(*c*) Place out the aiming posts.

(*d*) Slip the black coarse deflection scale to the referred deflection of 2800 mils.

(*e*) Record the deflection reading on the red deflection scales which coincides to the referred deflection on the black deflection scales.

(4) The gunner now uses the RED and BLACK scales to index deflections. Whenever it is impossible to sight on the front aiming posts using the RED scale, due to a sight block, the gunner indexes the deflection on the BLACK scale and lays it on the rear aiming posts.

(5) Caution must be exercised to insure that the gunner used ONLY the aiming posts put out at 2800 mils to the front when using the RED scale, and that he uses the aiming posts put out at 2800 mils to the rear when using the BLACK scale.

(6) The squad leader is responsible for insuring that the gunner uses the appropriate aiming posts when laying the mortar for deflection.

Note. To assist the squad leader in assuring that their gunners are on the appropriate aiming posts, the platoon leader may direct that each mortar squad place out cardinal direction stakes around their mortar position. The platoon leader should also direct the FDC to announce the general direction of fire prior to giving the initial fire command.

e. The M34A2 sight unit and the M53 sight unit can be used within the same firing section as long as the black deflection scale of the M53 sight unit numerically coincides with the red deflection scale. When the M34A2 sight unit and the M53 sight unit are used within the same firing section which is being utilized in a 6400-mil capability, the gunner must slip the black deflection scale of the M53 sight unit so that 0 mils on the black deflection scale coincides with 3200 mils on the red deflection scale. The gunner then uses the red deflection scale when laying on the front aiming posts, using deflections up to 3199 mils. He must use the black deflection scale when laying on the rear aiming posts, using deflections up to 3199 mils.

f. When the section is laid parallel, it is anticipated that the rounds will land in the impact area the same distance apart as the mortars are mounted (35–40 meters). However, this does not always occur and for this reason the forward observer must adjust the sheaf. Sheaf adjustment is normally accomplished after the base mortar is adjusted on the registration point. The FDC will cause the section to fire a section right (left) with the same charge and deflection setting as the base mortar. The forward observer will adjust numbers 1 and 3 mortars until they are in their proper position in the sheaf. Any adjustment of either mortar will result in that mortar having a different deflection. If this condition were permitted to exist it would be necessary to announce a different deflection for each mortar, to fire all three mortars as a section. In order to obtain identical sight settings, the sights are referred so that each sight has the same deflection reading. At the completion of the adjustment, the FDC sends the following fire command to the mortar section: SECTION, DEFLECTION (FDC announces the deflection of the base mortar) REFER AND REALINE AIMING POSTS. The gunner refers his sight to the deflection setting and without disturbing the lay of the mortar directs the second ammunition handler in moving the aiming posts until they are alined with the vertical crossline of the sight. The barrels of the mortars are parallel and each mortar has the same deflection reading.

61. Alternate Method of Placing Out Aiming Posts

a. After the section sergeant (platoon sergeant) has laid the section for direction, he will announce, SECTION, DEFLECTION (normally two eight hundred) REFER, PLACE OUT AIMING POSTS.

(1) The gunner determines which general direction will enable him to properly place out his aiming posts, and still allow a maximum traverse before encountering a sight block.

(2) Refers the sight to that general direction and indexes any deflection to the nearest 100 mils.

(3) Places out the aiming posts, assisted by the second ammunition handler.

(4) Slips the black coarse deflection scale to the referred deflection of 2800 mils.

(5) It is necessary to place out two additional aiming posts, to prevent a sight block, if the mortar is used in a 6400 mil capability. The section sergeant (platoon sergeant) must then select an area to the rear of each mortar where aiming posts can be placed on a common deflection for all mortars in the section. A common deflection of 0700 mils is preferred but if this is not possible due to obstacles, traffic patterns, or terrain, any common deflection to the rear may be selected.

(6) Record the deflection reading on the red deflection scale which corresponds to the referred deflection on the black deflection scales so that if the black deflection scale is inadvertently moved, it can easily be reindexed on the referred deflection.

b. After the section sergeant (platoon sergeant) has laid the section for direction, he will announce, SECTION, DEFLECTION (normally two eight hundred) REFER, PLACE OUT AIMING POSTS.

(1) through (4) are the same as *a.* (1) through (4) above.

(5) The gunner refers the sight to the back deflection of the referred deflection and directs the second ammunition bearer to place out two aiming posts, 50 and 100 meters from the mortar position. If the guns receive a deflection that would be obscured by the barrel, he will index the referred deflection and slip the coarse deflection slip scale 3200 mils and lay in on the rear aiming post.

62. Correction for Displacement of Sight

a. In laying the mortar for direction, the two aiming posts do not always appear as one when viewed through the sight (fig 27). This separation is caused by one of two things: either a large deflection shift of the barrel, or a rearward displacement of the baseplate assembly (caused by shock of firing).

b. When the aiming posts appear separated, the gunner cannot correctly use either one of them as his aiming point.

c. To lay the mortar correctly then, the gunner takes a compensated sight picture. He traverses the mortar until the sight picture appears as shown in figure 27, with the left edge of the aiming post placed exactly midway between the left edge of the near aiming post and the vertical line of the sight. This corrects for the displacement.

d. At the first lull in firing, the gunner determines if the displacement is caused by traversing the mortar or displacement of the baseplate assembly. To do this, he places the referred deflection on the sight and lays on the aiming posts. If both aiming posts appear as one, the separation is caused by traversing. In this case, he continues to lay the mortar as described and does not realine the aiming posts. When the posts still appear separated, the separation is caused by displacement of the baseplate assembly. He notifies his squad leader, who in turn requests permission from the section leader to realine the aiming posts.

(1) To realine the aiming posts using the M53 sight unit, the gunner—

(*a*) Places on the sight the deflection with which the posts were originally placed out.

(*b*) Lays the mortar so that the vertical line of the sight is alined on the left edge of the far aiming post.

(*c*) Without shifting the mortar, refers the sight until the vertical crossline falls on the left edge of the near aiming post. This actually measures the angle between the posts.

(*d*) With this last deflection set on the sight, re-lays the mortar until the vertical crossline is alined on the far aiming post.

(*e*) Without shifting the mortar, refers the sight again to the original referred deflection on which the aiming posts were placed out. The line of sight, through the sight, is now parallel to the original line established by the aiming posts.

(*f*) Looking through the sight, he directs the second ammunition handler to move the aiming posts so that they are realined with the sight's vertical line. The posts are now realined to correct for the displacement.

Note. This procedure will only be used when displacement is so great that it is difficult to obtain a compensated sight picture.

(2) To realine the aiming posts using the M34A2 sight unit, the gunner uses the same procedure as in (1) above.

63. Manipulation for Traversing Fire

a. Traversing fire is used to fire on exceptionally wide targets. It consists of firing a specified number of rounds with a specified number of turns (right or left) of the traversing gear handle between rounds. The gunner receives a command, for example:

PREPARE TO TRAVERSE RIGHT
FOUR ROUNDS
TRAVERSE RIGHT THREE TURNS
ELEVATION 900

b. He places elevation 900 on the sight. He then visually inspects the traversing assembly to insure that he has adequate traverse capability to complete the mission. If necessary, he must prepare to traverse right. To prepare to traverse right, he turns the traversing wheel body until the mortar is all the way to the left on the traversing assembly. Then he turns the traversing crank two turns to the right, allowing some lati-

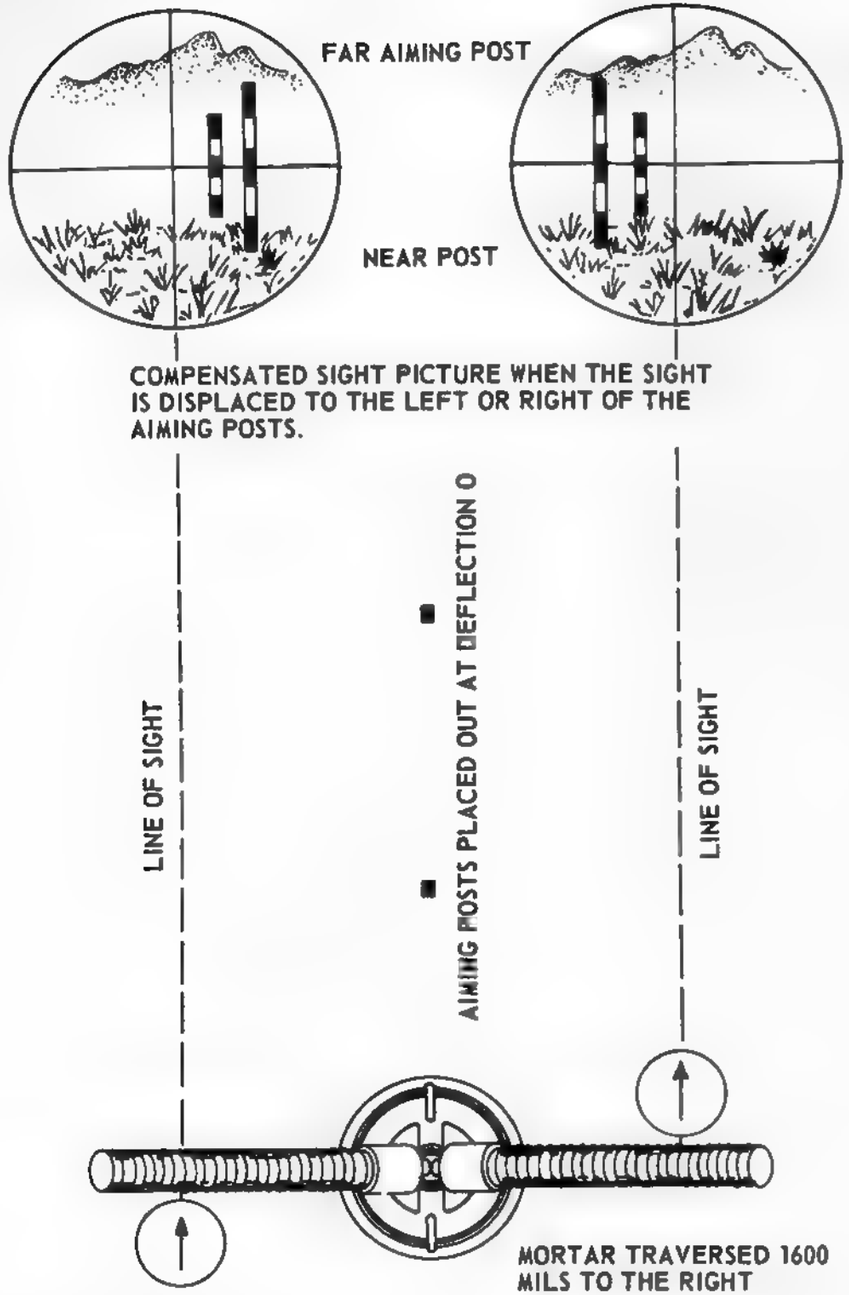


Figure 27. Compensated sight picture.

tude for the final adjustment on the aiming posts. If preparing to traverse left, he reverses this procedure.

c. The gunner and the assistant gunner shift the mortar and lay the mortar on the aiming posts. The gunner makes a final adjustment with the traversing crank.

d. When the gunner is satisfied with the lay of the mortar, he announces UP. The squad leader checks the lay and commands FIRE. The gunner commands FIRE ONE. The assistant gunner fires the first round. The gunner then traverses to the right three turns and commands FIRE TWO. When the round is fired, the gunner again traverses three turns to the right and continues the procedure until the four rounds are fired.

64. Night Firing

a. When firing the mortar at night, the mission will dictate whether noise and light discipline will be sacrificed in favor of speed. To counteract the loss of speed for night firing, consideration should be given to presetting both fuze and charge for illumination rounds with the presetting of charges for other rounds. The procedure for manipulating the mortar at night is the same as during daylight operations. To assist the gunner in these manipulations, the sight reticle is illuminated, and the aiming posts are provided with lights.

b. The instrument lights (para 24 and 26) illuminate the reticle of the sights and make the vertical crosslines visible. The hand light on the flexible cord is used to illuminate the scales and bubbles.

c. An aiming post light (para 29) is placed on each aiming post. This enables the gunner to see the aiming posts. Aiming posts are placed out at night in a manner similar to the daylight procedure (para 60). The lights must be attached to the posts before they can be seen and positioned by the gunner. The gunner must issue commands, such as NUMBER ONE, MOVE RIGHT, LEFT, HOLD, DRIVE IN, POST CORRECT. Tilt in the posts is corrected at daybreak. Some of the distance to the far post can be sacrificed if it cannot be readily seen at 100 meters. In this case, however, the near post should still be positioned approximately half the distance to the far post from the mortar. The far post light should be a different color from the one on the near post and be positioned so it appears *slightly higher*. Adjacent squads should alternate post light filters to avoid laying on the wrong posts. For example, 1ST SQUAD, NEAR POST—GREEN FILTER, FAR POST—RED FILTER; 2ND SQUAD, NEAR POST—RED FILTER, FAR POST—GREEN FILTER.

d. The mortar is laid for deflection by placing the vertical crossline of the sight in the correct relation to the center of the lights attached to the aiming posts. The procedure for laying the mortar is the same as discussed in paragraph 58.

e. The night lights may be used to aline the aiming posts without using voice commands.

(1) The gunner directs the second ammunition handler to place out the aiming posts. The second ammunition handler moves out 100 meters and turns on the night light of the far aiming post. The gunner holds the instrument night light in his right (left) hand, and by moving the light to the right (left), directs the second ammunition handler to move to the right (left). In order to insure that the second ammunition handler sees the light moving only in the desired direction, the gunner places his thumb over the light when returning it to the starting position. The gunner continues to direct the second ammunition handler to move the aiming post until it is properly alined.

(2) The gunner moves the instrument light a shorter distance from the starting position when he desires the second ammunition handler to move the aiming post a short distance.

(3) The gunner holds the light over his head (starting position) and moves the light to waist level when he desires to have the second ammunition handler place the aiming post into the ground. In returning the instrument light to the starting position, the gunner covers the light with his thumb in order to insure that the second ammunition handler sees the light move only in the desired direction.

(4) The gunner uses the same procedure described in (2) above when he desires the second ammunition handler to move the aiming post light to a position corresponding to the vertical hairline in the sight after the aiming post has been placed into the ground.

(5) The gunner reverses the procedure described in (3) above when he desires the second ammunition handler to take the aiming post out of the ground. The gunner places the uncovered light at waist level and moves it to a position directly above his head. He then directs alinement as required.

(6) When the gunner is satisfied with the alinement of the aiming posts, he signals the second ammunition handler to return to the mortar

position by making a circular motion with the instrument light.

Note. When the night light is used to signal, the gunner directs the light toward the second ammunition handler.

65. Safety Checks Before Firing

a. The gunner makes certain that—

(1) There is mask and overhead clearance.

(*a*) Since the mortar is normally mounted in defilade, there generally will be a mask such as a hill, trees, a building, or just a rise in the ground. Overhead interference may be caused by overhanging branches of trees or roofs of buildings. In any case, the gunner must insure that the round will not strike any obstruction.

(*b*) In selecting the exact mortar position, the leader checks quickly by eye for mask clearance and overhead interference. After the mortar is mounted, the gunner makes a more thorough check.

(*c*) The gunner will determine mask and overhead clearance by sighting along the top of the barrel with his eye placed near the baseplug. If the line of sight clears the mask, it is safe to fire. If not, he may still fire at the desired range by selecting a charge zone having a higher elevation for that particular range. When firing under the control of an FDC, he reports to the FDC the fact that mask clearance cannot be obtained at a certain elevation.

(*d*) Firing would be slowed if mask clearance checked before each firing. Eliminate the necessity for checking on every mission by determining minimum mask clearance. Do this by depressing the barrel until the top of the mask is sighted. Then level the elevation bubble and read the setting on the elevation scale and the elevation micrometer. That setting is the minimum mask clearance. When appropriate, the squad leader notifies the FDC of the minimum mask clearance elevation. Any target that requires that elevation or a lower one cannot be engaged from that position.

(*e*) If the mask is not regular throughout the sector of fire, determine the minimum mask clearance in the manner described in (*d*) above.

(*f*) Placing the mortar in position at night does not relieve the gunner of the responsibility of checking for mask clearance and overhead interference.

(2) The barrel is locked to the baseplate and the open end of the socket cap is pointing in the direction of fire. The barrel ring should be positioned between the etched markings on the barrel.

(3) The shock absorber clevis lock pin is secure.

(4) The locking sleeve is wrist tight.

(5) The chain is taut and is hooked to the left leg.

b. The assistant gunner sees that the bore is clean, and swabs the bore dry.

c. The ammunition bearer insures that each round is clean, the safety pin is present, and the ignition cartridge is in proper condition.

66. Loading and Firing

a. On receiving a fire command from the section leader, the gunner repeats each element of it. He places the firing data on the sight and, assisted by the assistant gunner, lays the mortar. The first ammunition handler repeats the charge element when announced by the gunner and prepares the round with that charge. (If a fuze setting is announced, the first ammunition handler also repeats the setttiŋg and places it on the fuze.) He completes his preparation of the cartridge to include the safety checks. The squad leader spot checks the data on the sight and the lay of the mortar. He then commands FIRE.

b. The crew fired the mortar as follows:

(1) The gunner removes the sight. He is careful not to disturb the lay of the mortar. He continues to remove the sight until the baseplate assembly is settled and there is no danger of the sight becoming damaged from the recoil of the mortar.

(2) The first ammunition handler passes a round to the assistant gunner. He holds the round with the palms of both hands up and near each end of the round so that the fuze is pointing in the general direction of the mortar.

(3) The assistant gunner takes the round from the first ammunition handler with his right hand, palm up, and his left hand, palm down. He grasps the body of the round near the center and guides it into the barrel to a point beyond the narrow portion of the body of the shell and releases it. He cuts both hands sharply away and down along the barrel. At the same time he pivots to the left and bends toward the first ammunition handler, extending his hands to receive the next round. He is careful not to disturb the lay of the mortar as he loads the round (the round may bind as the base end enters the barrel). This can cause considerable dispersion in the target area and may create unsafe conditions due to erratic fire.

67. Firing Malfunctions

a. Misfire. A misfire is a complete failure to fire. It may be caused by a faulty firing mechanism or a faulty element in the propelling charge explosive train. A misfire in itself is not dangerous, but since it cannot be immediately distinguished from a delay in functioning of the firing mechanism or from a hangfire, it must be handled with care. Mechanical malfunctions may be caused by a faulty firing pin, rounds lodging in the barrel because of burrs, excess paint, oversize rounds, or foreigh matter in the tube.

b. Hangfire. A hangfire is a delay in the functioning of a propelling charge explosive train at the time of firing. In most cases the delay, though unpredictable, ranges from a split second to several minutes. Thus, a hangfire cannot be distinguished immediately from a misfire.

c. Cookoff. A cookoff is a functioning of any or all of the explosive components of a round chambered in a very hot weapon, initiated by the heat of the weapon.

68. Procedures for Removing Ammunition From the Mortar in Case of Failure to Fire

a. When a firing malfunction occurs, any member of the squad noticing that a misfire has occurred immediately announces MISFIRE. All personnel, except the gunner, move a safe distance to the rear of the mortar. The gunner then kicks the barrel several times with his heel. This may dislodge the round; if the round fires, the mortar is re-laid and firing is continued.

b. If the round is not fired, the crew waits at least 1 minute before moving the round, to avoid a possible accident resulting from a delayed action of the propelling charge. The gunner tests the barrel for heat after the 1-minute wait and if the barrel is cool enough for handling removes the round as described below. If the barrel is hot, apply water on the outside of the barrel until it is cool. If no water is available, stand clear of the mortar until the barrel is cool.

c. After the barrel cools, the gunner removes the sight and depresses the barrel to the minimum elevation. The assistant gunner braces the right leg of the bipod by placing his left leg in front of it. The gunner rotates the barrel until it is unlocked from the baseplate. The assistant gunner then places his right hand, palm up, under the barrel near the muzzle, and his left hand, palm down, on top of the barrel. He places the thumbs of both hands alongside the forefingers, being careful to keep every part of either hand away from the muzzle.

d. The gunner lifts the base of the barrel until it is horizontal, Under no circumstances will he lower the base of the barrel below a horizontal position before the round has been removed. As soon as the barrel is in the horizontal position, and not before, the assistant gunner places the thumb of each hand over the muzzle.When the fuze reaches the muzzle, the assistant gunner stops the round with his thumbs. He then carefully removes the round and passes it to the first ammunition handler who inspects it to determine the cause of the misfire. If the primer of the ignition cartridge is dented he replaces the safety wire (if applicable) and places the round in a marked, safe location for disposition by ordnance personnel. If the primer is undented, the round may be used again.

e. The gunner shakes the barrel to dislodge any remnants from the last round fired, then locks the barrel.

f. If the procedure in *d*, above, fails to remove the misfire, keep the barrel in a horizontal position, remove it from the bipod, and lay it on the ground in a horizontal position until it can be turned over to ordnance for disposal.

69. Causes of Misfires

The propelling charge may not function for the following reasons:

a. Defective ignition cartridge.

b. Defective, damaged, or loose firing pin.

c. Firing pin fouled or obstructed by extraneous material.

d. Fouled bore.

e. Excess oil or water in bore.

f. Misalined stabilizing fin.

g. Foreign matter or excess paint on round.

70. Arm-and-Head Signals

When giving the commands FIRE or CEASE FIRING, the section leader or squad leader uses both arm-and-hand signals and voice commands.

a. I am ready or are you ready (1, fig 28). The signal for "I am ready" or "Are you ready?" is to extend the arm toward the person being signaled; then raise the arm slightly above the horizontal, palm outward.

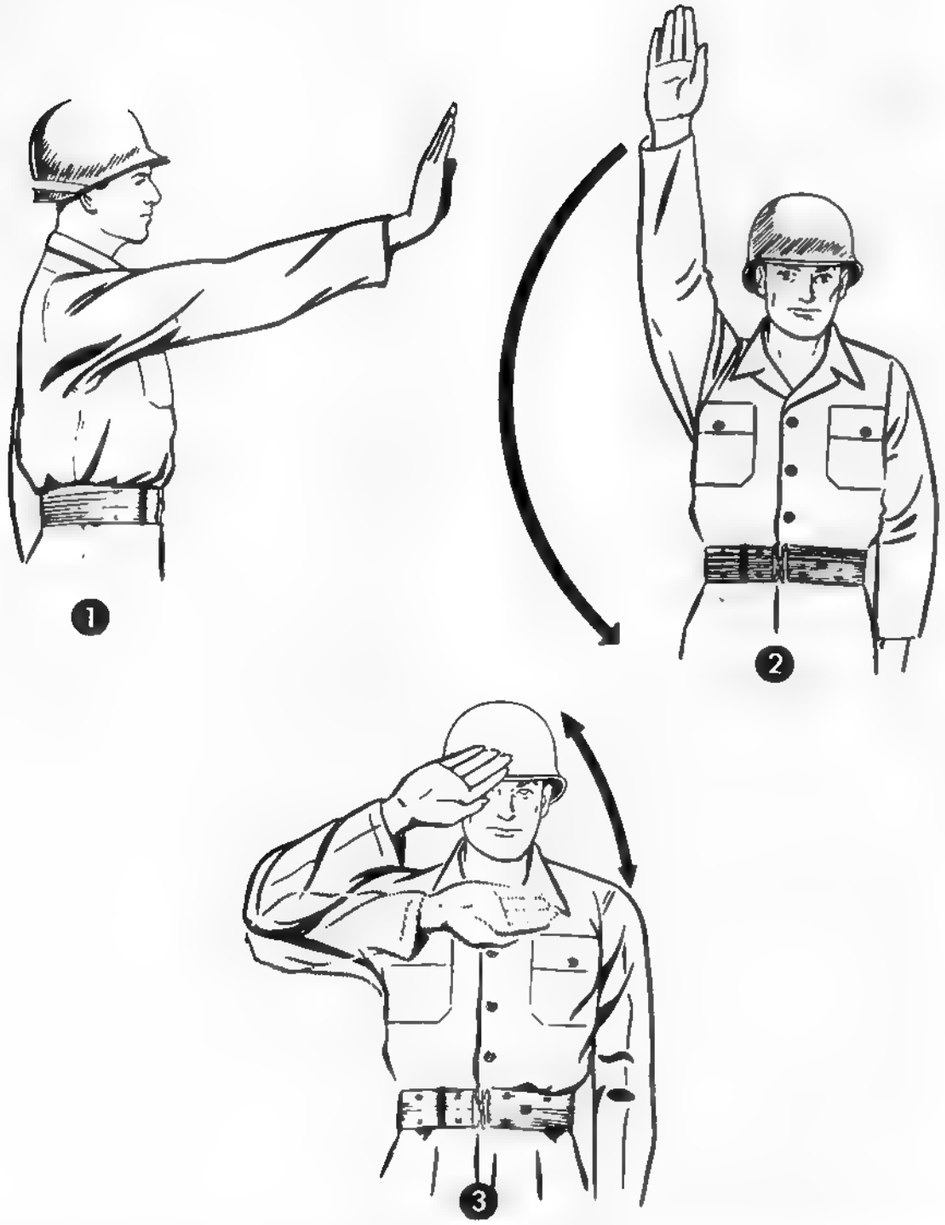


Figure 28. Arm-and-hand signals.

b. Fire (2, fig 28). The signal to fire is to drop the right arm sharply from a vertical position to the side. When the section leader desires to fire a single mortar, he points with his arm extended at the mortar to be fired, then drops his arm sharply to his side.

c. Cease Firing (3, fig 28). The signal for cease firing is to raise the hand in front of the forehead, palm to the front, and move the hand and forearm up and down several times in front of the face.

71. General

The purpose of squad drill is to develop teamwork within the mortar squad and to cross-train each mortar squad member in the other squad members' duties.

72. Duties

The section leader points out the mortar position and announces the initial direction of fire to the squad leaders.

73. Pre-Mount Checks

Before the mortar is mounted, the squad must perform pre-mount checks. Each squad member should be capable of performing all the pre-mount checks as follows:

a. The gunner performs the pre-mount checks on the mount.

(1) The spread chained is doubled, wrapped around the legs, and hooked, untangled, to the left leg.

(2) The clearance on the left leg above the adjusting nut is two fingers in width.

(3) The locking sleeve is neither too loose nor too tight.

(4) The traversing bearing is centered.

(5) The clevis locking pin is fully seated.

b. The assistant gunner performs the pre-mount checks on the barrel.

(1) Barrel ring is centered between the two white lines.

(2) Barrel is clean both inside and outside.

(3) Firing pin is visible.

(4) The spherical projection is clean and the firing pin is firmly seated.

c. The ammunition handler is responsible for the pre-mount checks on the baseplate.

(1) Checks the rotatable socket cap to insure that it moves freely and has a light coat of oil.

(2) Checks the ribs and braces for breaks and dents, and checks to see that the inner ring is secured to the outer ring (M23A1 baseplate).

d. When all pieces of equipment are checked, the gunner will notify the squad leader by announcing "ALL CORRECT".

Note. The squad leader supervises the conduct of squad drill and is responsible for supervising the laying out of the equipment as shown in figure 29. The equipment is placed out in the same manner for gunner's examination.

74. Mounting the Mortar

a. The squad leader picks up the sight case and two aiming posts and moves to the exact position where the mortar is to be mounted. He places the sight case and the aiming posts to the left front of the mortar position. He then points to the exact spot where the mortar is to be mounted. He indicates the initial direction of fire by pointing in that direction, and commands ACTION.

b. The first ammunition handler of the squad places the outer edge of the baseplate against the baseplate stake, so that the left edge of the cutout portion of the baseplate is alined with the left edge of the stake (fig 30). He then rotates the socket cap so that its open end is pointing in the direction of fire.

c. After the baseplate is in position, the gunner places his left hand on the traversing handwheel, his right hand on the sight slot, and lifts the bipod. He moves to the front, faces the baseplate, and places the bipod legs approximately 2 feet in front of the baseplate on line with the right edge, so that an extension of the right edge of the baseplate would bisect the interval between the closed legs. Kneeling on his right knee in front of the bipod and supporting it with his left hand on the gear case, he unhooks the doubled chain from the chain hook on the left leg, unwinds it, and rehooks the end loop on the chain hook. Lifting the left leg, he opens the legs to the full extent of the chain.

d. The gunner moves the elevating mechanism housing to the left until the traversing mechanism is in a horizontal position, and then tightens the locking sleeve.

e. The gunner rises and moves to the left rear of the bipod while supporting the bipod with his left hand on the shock absorber. He disengages the clevis lockpin and raises the yoke assembly to a horizontal position, keeping both hands on the shock absorber. He holds the clevis lockpin and chain out of the way with his right hand.

f. The assistant gunner inserts the barrel (mount attachment ring lug up and centered between the two white lines) into the yoke assembly with a slight twisting motion until the lug on the mount attachment ring fits into the shock absorber clevis (fig 31). The gunner locks the clevis to the barrel ring with the clevis lock pin. The assistant gunner inserts the spherical projection of the baseplug into the socket and rotates the barrel 90° to lock it to the baseplate.

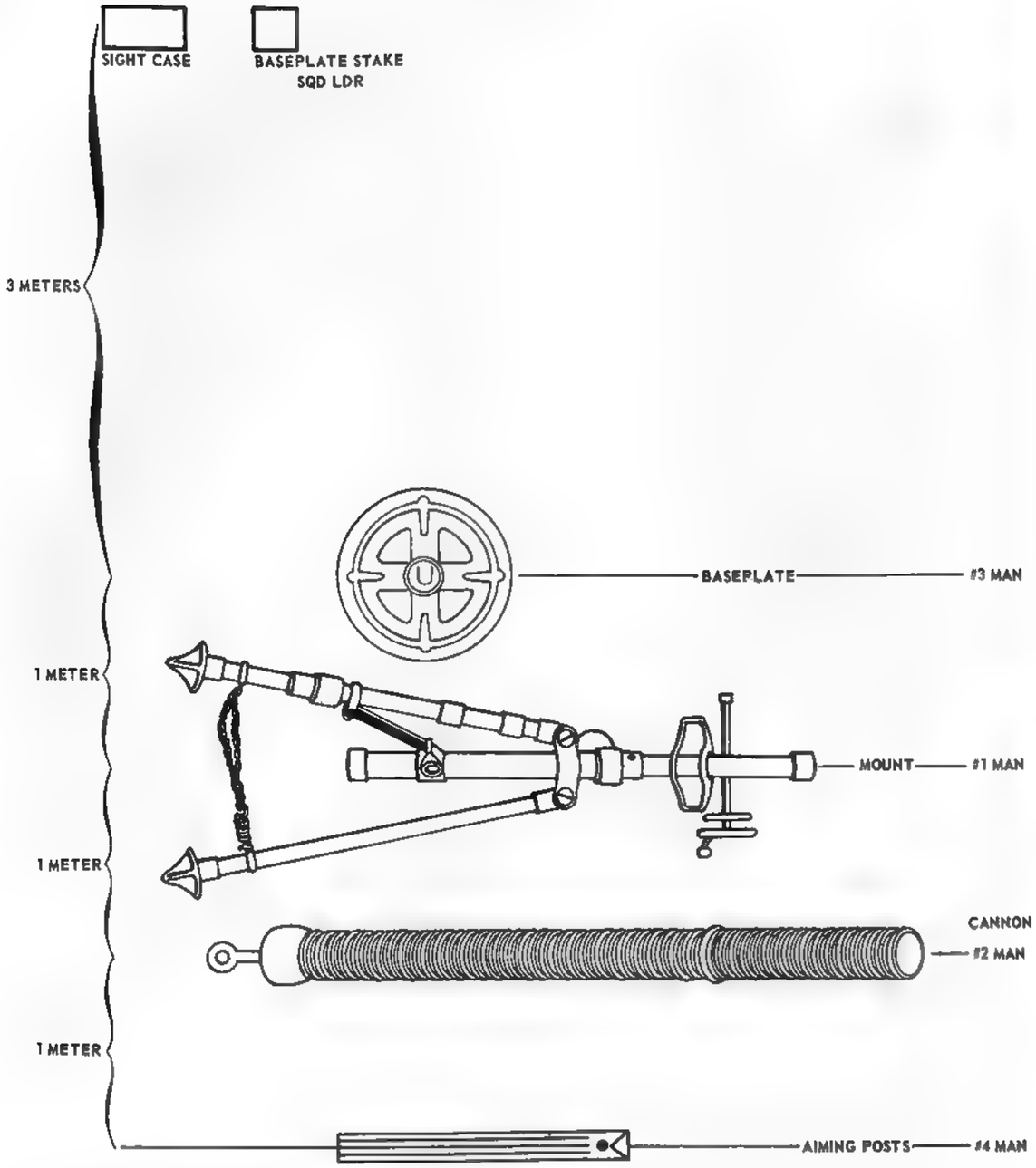


Figure 29. Layout of equipment.

g. The gunner then places the traversing crank in its operating position. Removing the sight from its case, he mounts it on the mortar and sets it at a deflection of 3200 and an elevation of 1100 mils. He centers the elevation level bubble, centers the cross-level bubble, then rechecks the elevation bubble.

75. Small Deflection and Elevation Changes

a. With the mortar mounted and the sight installed, the sight is laid on the two aiming posts (placed out 50 and 100 meters from the mortar) on a referred deflection of 2800 and an elevation

Figure 30. Placing baseplate against baseplate stake.

Figure 31. Securing the bipod and the mount attachment ring.

of 1100 mils. The mortar is within two turns of center of traverse. The vertical crossline of the sight is on the left edge of the aiming post.

b. The gunner is given a deflection change in a fire command, (part 35) between 20 and 60 mils, inclusive. The elevation change announced must be less than 90 mils and more than 35 mils.

c. As soon as the sight data is announced the gunner places it on the sight, lays the mortar for elevation and then traverses onto the aiming post by turning the traversing handwheel and the adjusting nut in the same direction. One-quarter turn on the adjusting nut equals one turn of the traversing handwheel. When the gunner is satisfied with his sight picture he announces UP.

Note. All elements given in the fire command are repeated by the gunner.

d. After the gunner has announced UP, the mortar should be checked by the squad leader to determine if the exercise was performed correctly.

76. Large Deflection and Elevation Changes

a. With the mortar mounted and the sight installed, the sight is laid on the two aiming posts

(placed out 50 and 100 meters from the mortar) on a referred deflection of 2800 mils and an elevation of 1100 mils.

b. The gunner is given a deflection and elevation change in a fire command (para 85) causing the gunner to shift the mortar between 100 and 200 mils inclusive and an elevation change between 100 and 200 inclusive.

c. As soon as the sight data is announced the gunner places it on the sight, elevates the mortar until the elevation bubble floats freely, and then centers the traversing bearing. This insures a maximum traversing capability after making the movement.

d. The assistant gunner moves into position to the front of the bipod on his right knee, places his right shoulder against gear case, and grasps the bipod legs (palms out), lifting until they clear the ground enough to permit lateral movement. The gunner moves the mortar as the assistant gunner steadies it, and attempts to maintain the traversing mechanism on a horizontal place. To make the shift, the gunner places his finger of his right hand in the muzzle (fig 32) his left hand on the left leg and moves the mortar until the vertical line of the sight is alined approximately on the aiming post. When the approximate alinement is completed, the gunner signals the assistant gunner to lower the bipod, by pushing down on the mortar.

e. The gunner centers the elevation bubble.

f. The gunner lays for deflection, taking the proper sight picture.

g. The mortar should be within two turns of center of traverse when the exercise is complete.

77. Referring the Sight and Realining Aiming Post Using the M53 Sight

a. The mortar is mounted and the sight is installed. The sight is laid on two aiming posts (placed out 50 and 100 meters from the mortar) on a referred deflection of 2800 mils and 1100 mils elevation. The mortar is within two turns of center of traverse. The gunner is given an administrative command to lay the mortar on a deflection of 2860 or 2740 mils. The mortar is then relaid on the aiming post using the traversing crank.

b. The gunner is given a deflection change between 5 and 25 mils, either increasing or decreasing from the last stated deflection. And the command to refer, realine aiming post.

Example: DEFLECTION 2875-REFER, REALINE AIMING POST.

Figure 32. Large deflection changes.

c. Upon receiving the command REFER, REALINE AIMING POST, two actions take place simultaneously in the mortar squad. The gunner places the announced deflection on the sight (without disturbing the lay of the weapon) and looks through the sight unit. At the same time, the first ammunition handler moves out on the double to realine the aiming posts. He knocks down the near aiming post and proceeds to the far aiming post. Following the arm-and-hand signals of the gunner (fig 26) who is looking through the sight unit, he moves the far aiming post so that the gunner will obtain an alined sight picture. The same procedure for alining the far aiming post is used to aline the near aiming post.

78. Referring the Sight and Realining the Aiming Posts Using the M34A2 Sight

The procedure for referring and realining the aiming posts using the M34A2 sight and the M53 sight is the same.

79. Dismounting

To dismount the mortar, the squad leader commands, OUT OF ACTION. At this command, the squad proceeds as follows:

a. The second ammunition handler retrieves the aiming posts. The gunner removes the sight, places an elevation of 900 and a deflection of 3200 mils on the M53 sight unit (or an elevation of 1650 and a deflection of zero mils on the M34A2 sight unit) and places it in the case. Then he lowers the mortar to its minimum elevation.

b. The assistant gunner turns the barrel 90°, lifts up on the base end of the barrel removes the barrel from the yoke assembly. He then turns to his left and places the barrel in the area designated by the squad leader.

c. The gunner disengages the clevis locking pin. The gunner moves to the front of the bipod and faces it, kneels on his right knee with his left hand on the gear case, loosens the locking nut, and unhooks the chain from the left leg. He tilts the bipod to his left and closes the bipod legs, placing the chain around the legs and rehooking the chain. He stands up, placing his right hand on the sight slot, and his left hand on the traversing handwheel.

d. The squad leader picks up the aiming posts and sight. At the command MARCH ORDER, the squad places the mortar, equipment, and ammunition in the squad vehicle and trailer.

Section IV. SECTION TRAINING

80. General

The mortar section is the basic fire unit for the mortar platoon. When a position is occupied, the mortars are emplaced 30–35 meters apart, making a section front (distance between flank mortars) of approximately 100 meters. The mortars are numbered 1, 2, and 3 from right to left when facing in the direction of fire, without regard to the permanent squad numbers within the section. (For example, the first squad is not necessarily Mortar No. 1.)

81. Platoon Sergeant (Section Sergeant)

a. General. The platoon sergeant (section sergeant) is located in the mortar section of the mortar platoon. He is responsible for the actions of the three mortar squads under his control.

b. Duties. The duties of the platoon sergeant (section sergeant) are as follows:

(1) Supervises occupation of the firing position.

(2) Lays the section.

(3) Checks communications with the FDC and mortar squads.

(4) Gives platoon sergeant's (section sergeant's) report (para 73) to the FDC.

(5) Has the mortar sights calibrated, if time permits.

(6) Controls the delivery of fires as commanded by the FDC.

(7) Insures that adequate and balanced stocks of ammunition are on hand and properly stored.

(8) Supervises the accounting of ammunition to include lot registration and control.

(9) Insures that the section is laid on final protective fire data when not otherwise engaged.

82. Laying the Section

a. When all mortars in the section are mounted, the section leader lays the section parallel on the prescribed azimuth with an aiming circle. The mortar section normally fires a parallel sheaf (fig 33). To obtain this sheaf, it is necessary to lay the mortars parallel. When a section moves into a firing position, the FDC determines the azimuth on which the section is to be laid and notifies the platoon sergeant (section sergeant). Prior to laying the mortars parallel, the mortar sights must be calibrated using the method discussed in paragraph 32. All mortars are then laid parallel using the aiming circle, the mortar sight, or a compass.

b. The section is normally laid parallel by following two steps:

(1) Establishing the 0–3200 line of the aiming circle parallel to the mounting azimuth (para 37).

(2) Laying the section parallel to the 0–3200 line of the aiming circle (reciprocal laying).

83. Reciprocal Laying

a. General. Reciprocal laying is a procedure by which the 0–3200 line of one instrument (aiming circle) and the 0–3200 line of another instrument (sight unit) are laid parallel. When the 0–3200 lines of an aiming circle and the 0–3200 line of the sight unit are parallel, the barrel will be parallel to both 0–3200 lines, if the sight has been properly calibrated. The principle of reciprocal laying is based on the geometric theorem which states that if two parallel lines are cut by a transversal, the alternate interior angles are equal. The parallel lines are the 0–3200 lines of the instruments, and the transversal is the line of sight between the two instruments. The alternate

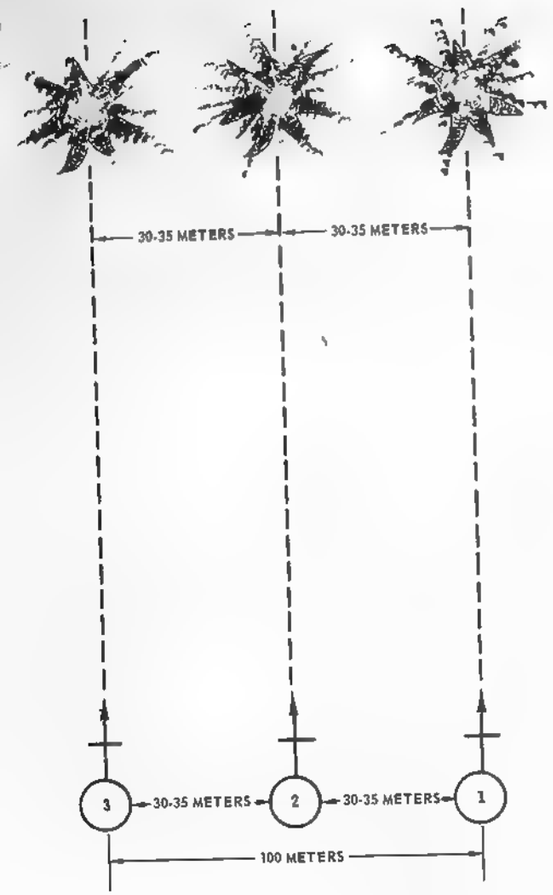


Figure 33. Parallel sheaf.

interior angles are the equal deflections placed on the instruments (fig 34).

b. Procedure. Orient the aiming circle so that the 0–3200 line of the aiming circle is parallel to the mounting azimuth (para 37). The section leader, using the upper motion, sights on the lens of the sight unit, reads the deflection on the azimuth micrometer scales, and announces the deflection to the gunner on the mortar. The gunner sets off the deflection on the sight unit and causes the mortar to be moved until the vertical crossline of the sight is sighted on the lens of the aiming circle and the mortar is level. When the sight has been sighted on the aiming circle, the gunner reports READY FOR RECHECK. The platoon sergeant (section sergeant) again sights on the lens of the sight unit, reads and announces the deflection. This procedure is repeated until the gunner reports a difference of ZERO (or ONE) MIL between successive deflections. The mortar has then been laid.

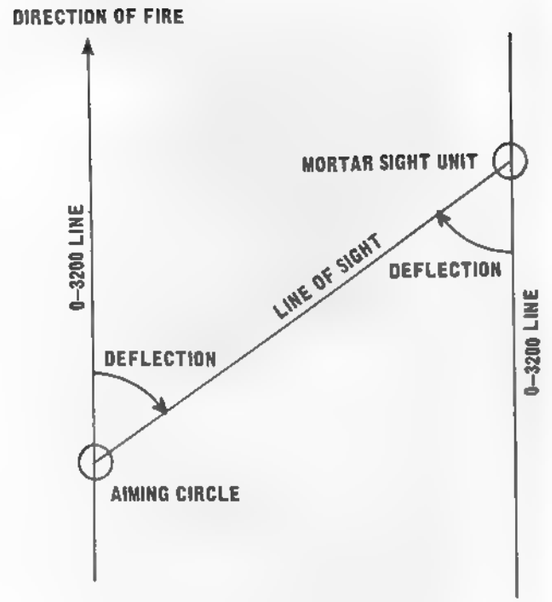


Figure 34. Principles of reciprocal laying.

c. Reciprocal Laying on a Grid Azimuth. The following illustrates the commands and procedures used in reciprocal laying of the mortar section on a given grid azimuth.

(1) The FDC normally directs the section to lay the mortar parallel on a mounting (grid) azimuth.

(2) The platoon sergeant (section sergeant) receives the command MOUNTING AZIMUTH 5580 MILS from the FDC.

(*a*) The mounting azimuth is 5550 mils and the aiming circle has a declination constant of 450 mils.

Declination constant	450 mils
	+6400 mils
	6850 mils
Minus the mounting (grid) azimuth	−5550 mils
Remainder to set on aiming circle	1300 mils

(*b*) The platoon sergeant (section sergeant) mounts and levels the aiming circle (para 37) at a point from which he can observe the sights of all the mortars in the section (normally the left front or left rear of the section).

(*c*) He places 1300 mils on the azimuth and micrometer scales of the aiming circle (recording motion).

(*d*) Using the orienting knob, he centers the magnetic needle in the magnetic needle magnifier. This orients the 0–3200 line of the aiming circle in the desired direction (mounting azimuth 5550 mils).

(*e*) The platoon sergeant (section sergeant) announces SECTION, AIMING POINT THIS INSTRUMENT.

(*f*) All gunners refer their sights to the aiming circle with the vertical crossline laid on the center of the aiming circle. The gunner then announces NO. 2 (1 or 3), AIMING POINT IDENTIFIED.

(*g*) To lay the mortar barrel parallel to the 0–3200 line of the aiming circle, the platoon sergeant (section sergeant) turns the upper motion of the aiming circle until the vertical crossline is laid on the center of the lens of the mortar sight. He reads the azimuth and micrometer scales and announces the deflection. For example, NO. 2 DEFLECTION 1998.

Note. When the M53 sight unit is used, it is calibrated at 3200 mils on the red deflection and micrometer scales. All readings from the aiming circle to the sight are placed on the red deflection scale and the mortar is laid on the aiming circle using this scale. Readings from 0 to 6400 must be given to the mortar when the M53 sight unit is used. When the M34A2 sight unit is used, the aiming circle operator never reads a deflection greater than 3200 mils, because the gunners cannot place deflections greater than 3200 mils on their sights. When the deflection is more than 3200 mils (on the azimuth scale), the operator reads the deflection from the lower row of figures (the back azimuth scale).

(*h*) The gunner repeats the announced deflection.

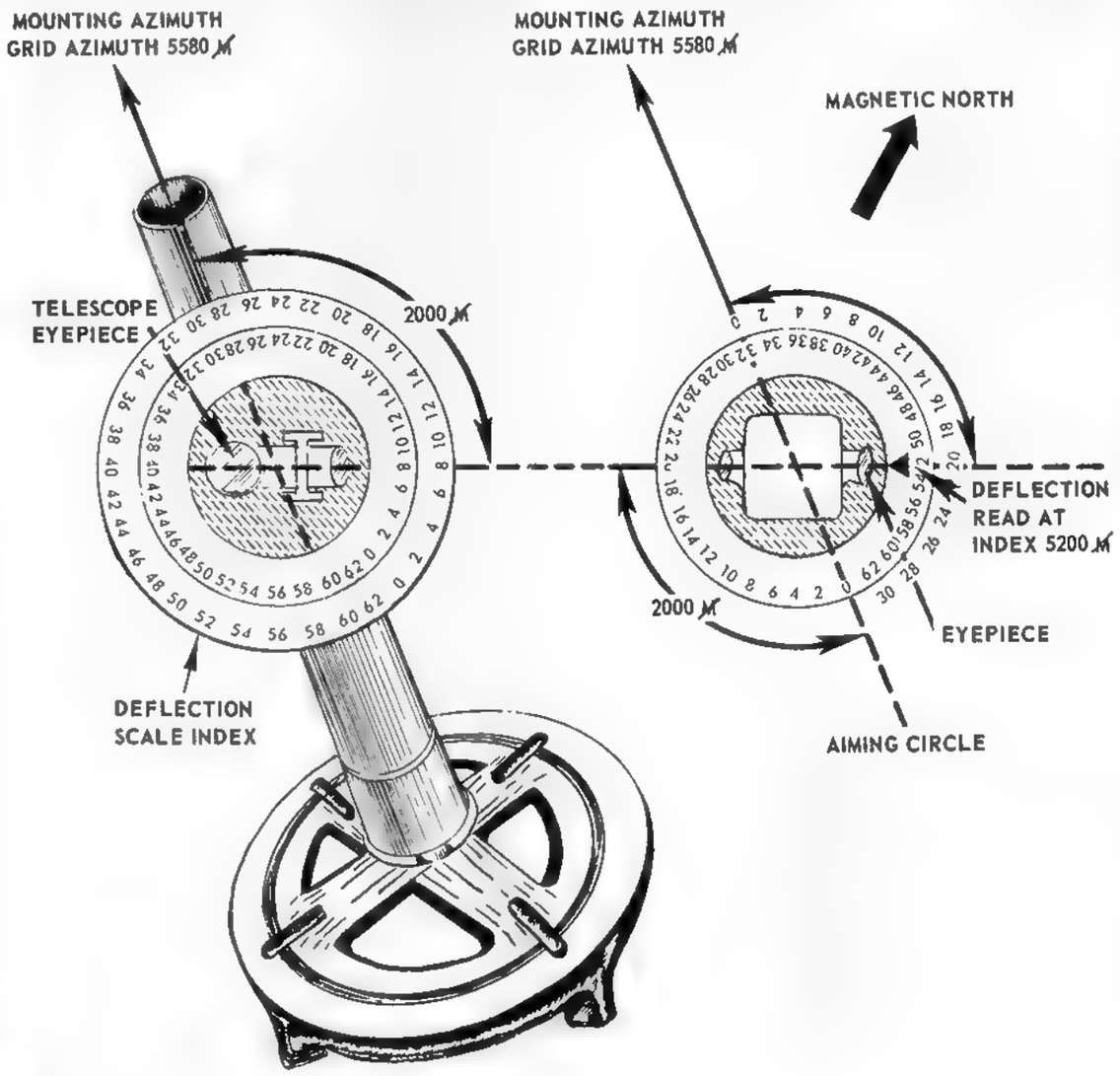


Figure 35. Mortar laid parallel with the aiming circle.

flection (NO. 2, DEFLECTION 1998) and places it on his sight. Assisted by the assistant gunner, he lays the mortar so that the vertical line is once again laid on the center of the aiming circle. After the mortar has been laid and the bubbles are level, the gunner announces NO. 2, READY FOR RECHECK.

(*i*) Using the upper motion, the platoon sergeant (section sergeant) again lays the vertical crossline of the aiming circle on the lens of the mortar sight. He reads the new deflection from the azimuth and micrometer scales and announces the reading. For example, NO. 2, DEFLECTION 2000 (fig 35).

(*j*) The gunner repeats the new deflection (NO. 2, DEFLECTION 2000) and places it on his sight. Assisted by the assistant gunner, he lays the mortar with the vertical crossline of the sight on the center of the aiming circle and announces NO. 2, READY FOR RECHECK.

(*k*) The above procedure is repeated until the mortar sight and the aiming circle are sighted on each other with a difference of not more than ONE mil between the deflection readings. When so laid, the gunner announces NO. 2 (1 or 3), ZERO MILS (ONE MIL), MORTAR LAID. The mortar barrel is now laid parallel to the 0–3200 line of the aiming circle (fig 34).

(*l*) The platoon sergeant (section sergeant) uses the same procedure to lay each of the other mortars in the section parallel. When all mortars are parallel to the 0–3200 line of the aiming circle, they are parallel to each other and laid in the desired azimuth (fig 36).

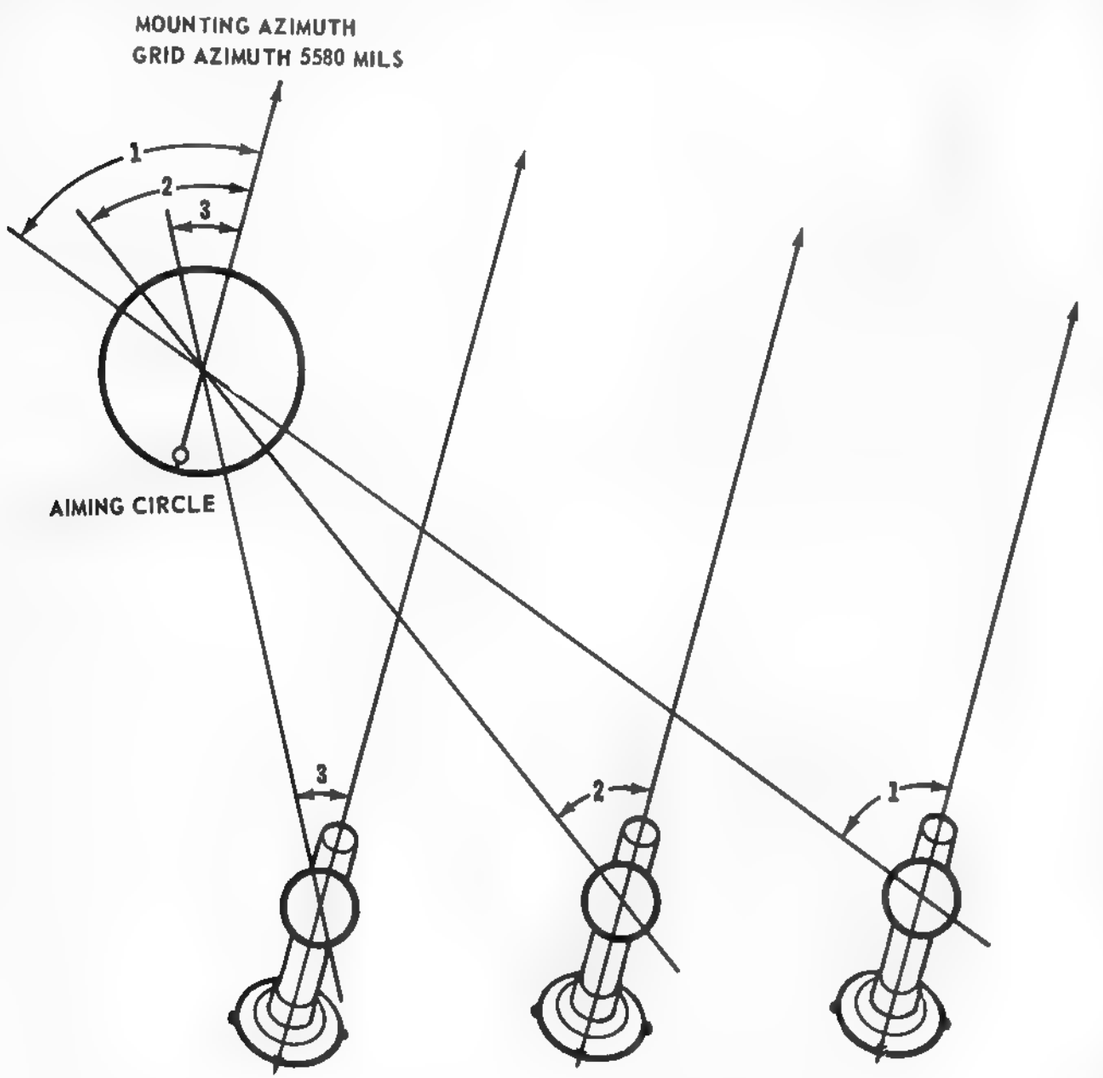


Figure 36. Mortars laid parallel in the desired azimuth.

Note. The section can be laid parallel rapidly by laying all mortars simultaneously. The instrument operator reads deflections to each of the mortars in turn. As soon as the gunner of any mortar announces READY FOR RECHECK, the instrument operator reads the new deflection to that mortar. By laying all mortars at the same time, the section is ready to fire in a minimum of time.

(*m*) As soon as each mortar is laid, the platoon sergeant (section sergeant) commands DEFLECTION 2800, REFER, PLACE OUT AIMING POSTS. (The aiming posts are normally placed out on a referred deflection of 2800 mils.) The gunner, without disturbing the lay of the mortar, places the announced deflection on his sight and alines the aiming posts with the vertical line of the mortar sight. He then announces UP.

(*n*) When all mortar gunners announce UP, the instrument operator covers the head of the aiming circle, but leaves the instrument in position to permit a rapid recheck of any mortar if this proves necessary.

d. Reciprocal Laying on a Magnetic Azimuth. Although the section is normally laid parallel on a grid azimuth, it can be laid parallel on a magnetic azimuth by—

(1) Subtracting the magnetic mounting azimuth from 6400 mils and setting the remainder on the azimuth and micrometer scales of the aiming circle.

(2) Orienting the instrument as described in paragraph 37.

(3) Laying the section as described in *c*(2) (*e*) through (*n*) above.

e. Reciprocal Laying Using the Orienting Angle. The mortars of each section can be laid parallel more accurately if the instrument operator lays the section parallel by using the orienting angle (para 37).

(1) Set up and level the aiming circle.

(2) Orient the aiming circle as described in paragraph 37.

(3) Lay the section as described in *c*(2)(*e*) through (*n*) above.

f. Reciprocal Laying Using the Mortar Sights. The mortar section can be laid parallel by using the mortar sights. For this method, it is best to have the mortars positioned so that all sights are visible from the base mortar. The base mortar (normally No. 2) is laid in the desired direction of fire by compass or by registration on a known point. After the base mortar is laid for direction, the remaining mortars are laid parallel to the base mortar as follows:

(1) The platoon sergeant (section sergeant) moves to the mortar sight of the base mortar and commands SECTION, AIMING POINT THIS INSTRUMENT. The gunners of the other mortars refer their sights to the sight of the base mortar and announce AIMING POINT IDENTIFIED.

(2) The platoon sergeant reads the deflection from the red scale on the sight of the base mortar. He then determines the "BACK AZIMUTH" of that deflection and announces it to the other gunners.

Note. A back azimuth is determined by adding or subtracting 3200 to the initial deflection. For example, NO. 3, DEFLECTION 1200.

(3) Each gunner repeats the announced deflection for his mortar, places the deflection on his sight, (using the red fixed scale) and re-lays on the sight of the base mortar. When the lens of the base mortar sight is not visible, the gunner lays the vertical crossline of his sight on one of the other three mortar sights and is laid in by this mortar once it is parallel to the base mortar sight unit (fig 37). He then announces NO. 1 or 3, READY FOR RECHECK.

(4) After each mortar has been laid parallel within zero (or one mil), the mortar barrels are parallel to the base mortar (fig 38).

(5) As soon as each mortar is laid, the platoon sergeant (section sergeant) commands NO. 3, DEFLECTION 2800, REFER, PLACE OUT AIMING POSTS.

Figure 37. Sighting on the mortar sight.

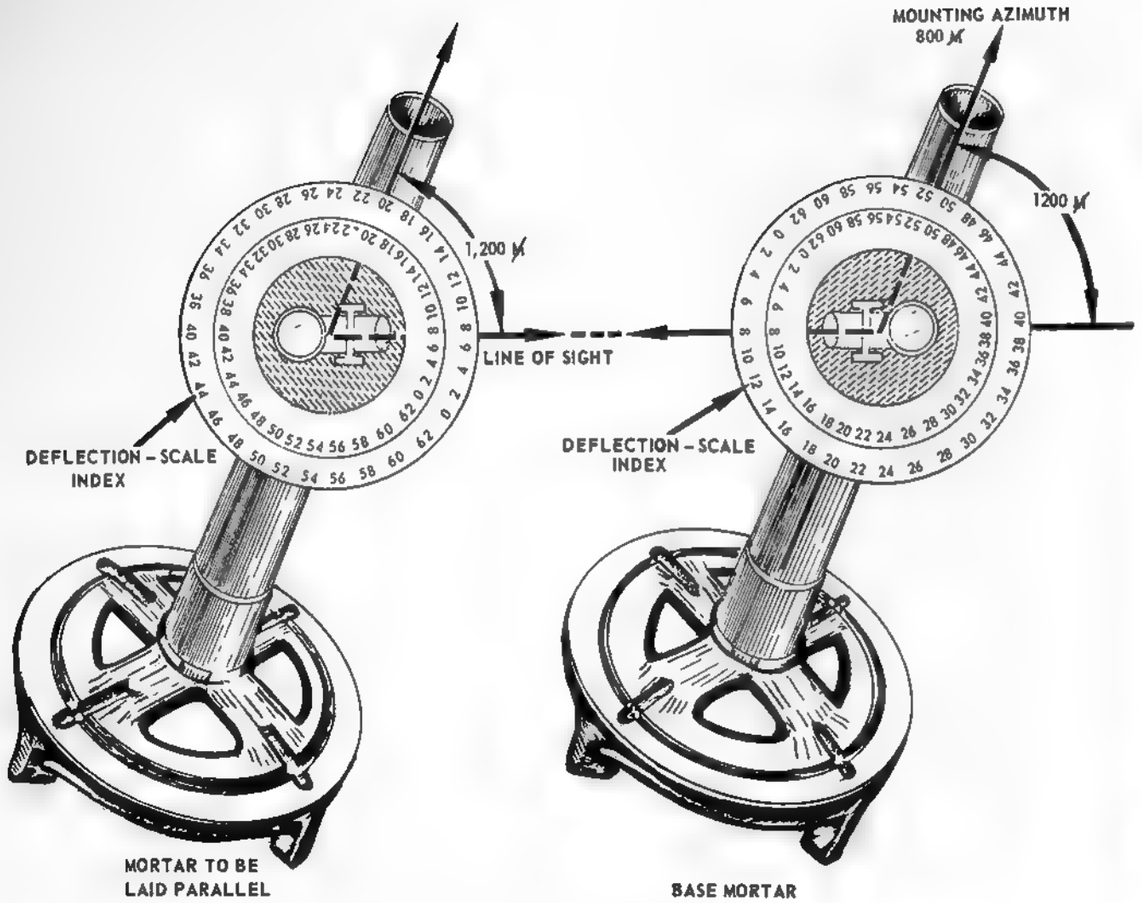


Figure 38. Mortar laid parallel with sights.

g. Reciprocal Laying Using the M2 Compass. A rapid means of laying the section parallel is by using the compass. This is an alternate means and is used only when an aiming circle is not available or when time dictates. It is not as accurate as the methods previously described.

(1) Before mounting the mortars, each squad leader places a base stake in the ground to mark the approximate location of the mortar.

(2) The platoon sergeant (section sergeant) announces the desired mounting azimuth as MOUNT MORTARS, MAGNETIC AZIMUTH 2212.

(3) Each squad leader places his compass on the base stake marking the location of his mortar and orients the compass on the desired mounting azimuth. By sighting through the compass, he directs the second ammunition handler in alining the aiming posts along the mounting (magnetic) azimuth.

(4) Each mortar is then mounted and laid on the aiming posts with a deflection of 3200 (zero on the M34A2 sight) placed on the sight. If no mechanical or human error exists, the mortar barrels are now laid parallel. This is normally not true, however, since both mechanical and human error will exist.

Note. Recognizing the difference in individual compasses, the platoon sergeant (section sergeant) may prescribe that all mortars be laid with one compass. This eliminates some mechanical error. It is also possible to lay only the base mortar as described above and then lay the remaining mortars parallel using the mortar sight method. In any event, the compass method is used only when the aiming circle or mortar sight method is not practical.

84. Reporting of Data by Firing Section (Platoon Sergeant's (Section Sergeant's) Report)

The fire direction center requires certain data from the firing section for the construct of firing charts, for the attack of targets, and for the *met* message computation. The platoon sergeant (section sergeant) reports the following information as time permits:

a. Referred deflection.

b. Limitations to all-round (6400 mils) fire because of obstacles.

c. Limitations in elevation because of obstacles.

d. Complete ammunition report to include amount, type, fuzes, lot number, distribution, weight zone, and powder temperature.

85. Fire Commands and Their Execution

a. General. Fire commands are the technical instructions issued to enable mortar crews to engage a target. The basis for these commands is the data processed in the FDC. There are two types of commands: initial fire commands, issued to start a fire mission; and subsequent fire commands, issued to change firing data and to cease firing. The elements of both commands follow the same sequence. However, subsequent commands include only such elements as are changed, except that the elevation element is always announced. A correct fire command is brief, clear, and includes all the elements necessary for accomplishing the mission. The commands are sent to the platoon sergeant (section sergeant) by the best available means. To minimize errors in transmission, the person receiving the commands at the mortar position repeats each element as it is received.

b. Initial Fire Command.

(1) The sequence for the transmission of fire commands is given below:

Sequence	*Example*
Mortars to follow	Section
Shell and fuze	HE quick
Mortars to fire	Number two
Method of fire	One round
Deflection	Deflection two eight hundred
Charge	Charge eight and four eighths
Time	----------
Elevation	Elevation niner hundred

Note. All fire commands follow this sequence. Elements not necessary for the proper conduct of fire are omitted.

(2) The explanation of fire commands—

(*a*) *Mortars to follow.* This element serves two purposes: it alerts the section for a fire mission and it designates the mortars that are to follow the commands. The command for all mortars in the section to follow the fire command is SECTION. Commands for individual or pairs of mortars are given as NUMBER (1, 2, etc).

(*b*) *Shell and fuze.* This element alerts the ammunition handlers as to what type of ammunition and fuze action to prepare for firing. For example, HE QUICK; HE DELAY; HE PROXIMITY; etc.

(*c*) *Mortar(s) to fire.* This element designates the specific mortar(s) to fire. If the mortars to fire are the same as the mortars to follow, this element will be ommitted. The command to fire an individual mortar or any combination of mortars if NUMBER(s) (1, 3, etc).

(*d*) *Method of fire.* In this element, the mortar(s) designated to fire in the preceding element is told how many rounds to fire, how to engage the target, and any special control desired. Also included is the number and type ammunition to be used in the fire for effect phase.

1. Volley fire. A volley may be fired by one or more mortars. The command for volley fire is (so many) ROUNDS. Once all mortars are reported UP, they fire on the platoon sergeant's (section sergeant's) command. If more than one round is being fired by each mortar, the squads fire the first round on command and the remaining as rapidly as is consistent with accuracy and safety, and without regard to other mortars. If a specific time interval is desired, the command is (so many) ROUNDS AT (so many) SECONDS INTERVAL, or (so many) ROUNDS PER MINUTE. In this case a single round per mortar, at the time interval indicated, is fired at the platoon sergeant's (section sergeant's) command.

2. Section right (left). This is a method of fire in which mortars are discharged from the right (left) one after the other, normally at 10-second intervals. The command for section fire from the right (left) flank at intervals of 10 seconds is SECTION RIGHT (LEFT), ONE ROUND. After all mortar squads report UP, the platoon sergeant (section sergeant) gives the command FIRE. For example, SECTION RIGHT, ONE ROUND; the platoon sergeant (section sergeant) commands FIRE ONE; 10 seconds later FIRE TWO, etc. If the section is firing a section left, the fire begins with NO. 4 and works to the right. The command LEFT (RIGHT) designates the flank from which the fire will begin. The platoon sergeant (section sergeant) fires a section right (left) at 10-second intervals unless he is told differently by the FDC; for example, SECTION LEFT, ONE ROUND, 20-SECOND INTERVALS.

3. When it is desired to fire continuously at a target, the command is CONTINUOUS FIRE. When it is desired to maintain a smoke

screen, it may be necessary to fire a series of sections right (left). In this case the command is CONTINUOUS FIRE FROM THE RIGHT (LEFT). The platoon sergeant (section sergeant) then fires the designated mortars consecutively at 10-second intervals unless a different time interval is specified in the command. Changes in firing data (deflections and elevations) are applied to the mortars in turns of traverse or elevation in order not to stop or break the continuity of fire. For example, NO. 1, RIGHT THREE TURNS; NO. 2, UP ONE TURN. When continuous fire is given in the fire command, the platoon sergeant (section sergeant) continues to fire the section until the FDC changes the method of fire or until the command END OF MISSION is given.

4. Traversing fire. In traversing fire, rounds are fired with a designated number of turns of traverse between each round (para 54). The command for traversing fire is (so many) ROUNDS, TRAVERSE RIGHT (LEFT) (so many) TURNS. At the platoon sergeant's (section sergeant's) command FIRE, all mortars fire one round, traverse the specified number of turns, fire another round, and continue this procedure until the number of rounds specified in the command have been fired.

5. Searching fire. Searching fire is fired the same as volley fire except that each round will normally have a different range. No specific order is followed in firing the rounds. For example, the assistant gunner will not start at the shortest range and work up to the highest charge or vice versa, unless he is instructed to do so. Firing the rounds in a definite sequence (high to low or low to high), establishes a pattern of fire which can be detected by the enemy.

6. At my command. If the FDC desires to control the fire, the command AT MY COMMAND is placed in the method of fire element of the fire command. When all mortars are reported UP, the platoon sergeant (section sergeant) reports to the FDC: SECTION READY. The FDC then gives the command FIRE.

7. Do not fire. The FDC May command DO NOT FIRE immediately following the method of fire. DO NOT FIRE then becomes a part of the method of fire. This command is repeated by the platoon sergeant (section sergeant) as soon as the weapons are laid the platoon sergeant (section sergeant) reports to FDC that the section is laid. The command for the section of fire is the command for a new method of fire not followed by DO NOT FIRE.

(*e*) *Deflection.* This element gives the exact deflection setting to be placed on the mortar sight. It is always announced in four digits, and the word DEFLECTION always precedes the sight setting. For example, DEFLECTION TWO EIGHT FOUR SEVEN (2847). When the mortars are to be fired with different deflections, the number of the mortar is given and then the deflection for that mortar. For example, NO. 3, DEFLECTION TWO FOUR ZERO ONE (2401).

(*f*) *Charge.* This element gives the charge consistent with elevation and range as determined from the firing tables; for example, CHARGE FOUR (4). The word CHARGE always precedes the amount. For example, ONE ROUND, CHARGE FOUR (4).

(*g*) *Time.* The computer notifies the ammunition handler the exact time setting to place on the proximity, MTSQ, and the MT fuze. The command for time setting is TIME (so much); for example, TIME TWO SEVEN. The command for a change in time setting is a new command for time.

(*h*) *Elevation.* This element serves two purposes: first, it gives the exact elevation setting that is to be placed on the mortar sight; second, it serves as the command to fire, if no restrictions are placed on method of fire. When no restrictions are announced in the method of fire, the section, when laid, fires at the platoon sergeant's (section sergeant's) command FIRE. The platoon sergeant (section sergeant) may allow the mortar(s) to fire when ready if desired. The elevation element is always given in a fire command. It is announced as ELEVATION (so many mils).

c. Subsequent Fire Command. Only the elements which change from the previous fire command are announced in this command; however, the elevation element (command to fire) is always announced in the subsequent fire command.

(1) Changes in direction are given in total deflection to be placed on the sight; example, DEFLECTION 2812.

(2) When a change is made in mortars to fire or in the method of fire, the subsequent command includes one or both of these elements and the elevation.

(3) When the elevation does not change, the command ELEVATION (so many mils) is given (same as that given in the previous command).

(4) To interrupt firing, CEASE FIRING, or CHECK FIRE is commanded.

(*a*) CEASE FIRING indicates to the section the completion of a fire mission, but not necessarily the end of the alert. Firing is renewed by issuing a new initial fire command.

(*b*) CHECK FIRE indicates a temporary cessation of firing and allows firing to be resumed with the same data by the command RESUME FIRING or by a subsequent fire command.

(5) So that the mortar crews may relax between fire missions, the end of the alert is announced by the command END OF MISSION. All gunners then lay their mortars as directed by the FDC. Upon completion of a fire mission, all mortars normally lay on final protective fire data unless otherwise directed. It is the responsibility of the platoon sergeant (section sergeant) to insure that the mortars are laid on final protective fire data and that the prescribed amount of ammunition for the final protective fire is prepared and on position.

d. Repeating commands. If the platoon sergeant (section sergeant) or squad member fails to understand any elements of the fire command, he may request that element be repeated by starting, for example, SAY AGAIN DEFLECTION, ELEVATION, etc. Misunderstanding is avoided when the repeated element is prefaced with I SAY AGAIN DEFLECTION_____.

e. Correcting Commands.

(1) In an initial fire command, an incorrect element is corrected by stating CORRECTION and giving only the corrected element.

(2) In a subsequent command, an incorrect element is corrected by stating CORRECTION and then repeating the entire subsequent command. The term correction in this case cancels the entire command.

86. Reporting Errors in Firing

When any squad member discovers that an error has been made in firing, he immediately notified his squad leader, who in turn notifies the FDC. Such errors include, but are not limited to, incorrect deflection or elevation settings, incorrect laying of the mortar, or ammunition improperly prepared for firing. Misfires are also reported in this manner. Errors should be reported promptly to the FDC in order to prevent excessive loss of time in determining the cause and the required corrective action.

Section V. SECTION DRILL

87. Exercise in Section Drill

a. To gain proficiency in working as a section, the section is drilled in all aspects of section training under the supervision of the platoon sergeant (section sergeant). For these drills the section—

(1) Can start the drill by occupying a position and then laying the section parallel using one of the methods previously described in paragraph 83.

(2) In the case of a limited movement area, the section can start the drill by laying parallel using one of the methods previously described in paragraph 83.

b. The platoon sergeant (section sergeant) issues a series of fire commands which are considered normal for actual operations. The squads and individuals within the squads are required to perform their duties according to the procedure described in paragraphs 73–79. The squads are checked each time a fire command is issued to insure that the mortar is laid correctly and by prescribed procedures.

c. At intervals, the squad is given the command to refer and realine their aiming posts and to remove misfires from the mortar.

d. To insure that every man becomes proficient in all squad duties, the squad members are rotated frequently within the squad.

e. Section training is a responsibility of the commander concerned. His imagination and ingenuity will determine the value of this training. For this reason, a prescribed sequence of training is not listed. Guidelines for a training program can be found in Army subject schedules and training programs.

88. Mortar Emplacements

a. The mortars are normally emplaced 30–35 meters apart. Terrain and the necessity for using all available cover and concealment may require that the mortars be emplaced irregularly in a staggered formation. However, they should not be separated or staggered so much that the section leader cannot control and supervise their firing.

b. Mortar emplacements are classified by type: drill, surface, and prepared. The type emplacement employed depends on the mission, the time available for preparation, the tactical situation (including air and counter-battery capabilities), and the ground on which the mortar is to be emplaced.

c. The drill emplacement is used for instructional purposes. The baseplate assembly is placed

on the ground and the mortar is mounted with sandbags or ammunition boxes supporting the spade.

d. The surface emplacement is used to fire the mortar prior to construction of a prepared emplacement. A hole approximately 8 inches deep is dug for the baseplate assembly, and earth is removed as necessary to allow shifting the bridge throughout a 6400-mil sector. Sandbags should be placed on the baseplate and bridge assemblies to improve stability. A level platform must be dug when the mortar is to be emplaced on a slope.

e. A prepared emplacement is constructed as soon as possible after moving into position. It provides protection against enemy fire for the crew, for the mortar, and for the ammunition. For a description of prepared emplacements, see FM 5–15.

CHAPTER 3

MOUNTED DRILL

89. General

This chapter is an instructional guide for supervisory personnel of carrier-mounted mortar squads. It covers basic firing procedures used in operating the mortar from the M125A1 carrier.

90. Weapons and Equipment

The carrier-mounted mortar squad has the weapons and equipment necessary to perform its tactical mission of providing close and continuous indirect fire support to the carrier-mounted rifle elements.

91. Training

Conduct of squad drill procedures within the carrier is based on proficiency obtained earlier through squad training conducted with the 81-mm mortar in its ground-mounted configuration. All squad members must have a thorough knowledge of mortar gunnery and be proficient in both assigned and secondary duties. In training, squad members are rotated through the crew positions.

92. Squad Composition and Positions

a. Composition. A typical mounted mortar squad consists of the—

(1) Squad leader, and/or track commander.

(2) Gunner.

(3) Assistant gunner.

(4) Ammunition handler.

(5) Driver and assistant ammunition handler.

b. Positions.

(1) *Dismounted.* When conducting squad drill, the squad, with the exception of the driver, forms at close interval to the rear of the carrier, which has the ramp lowered (fig 39). The driver stands where he can move directly to the forward end of the carrier and mounts from the front of the carrier which reduces crowding in the rear.

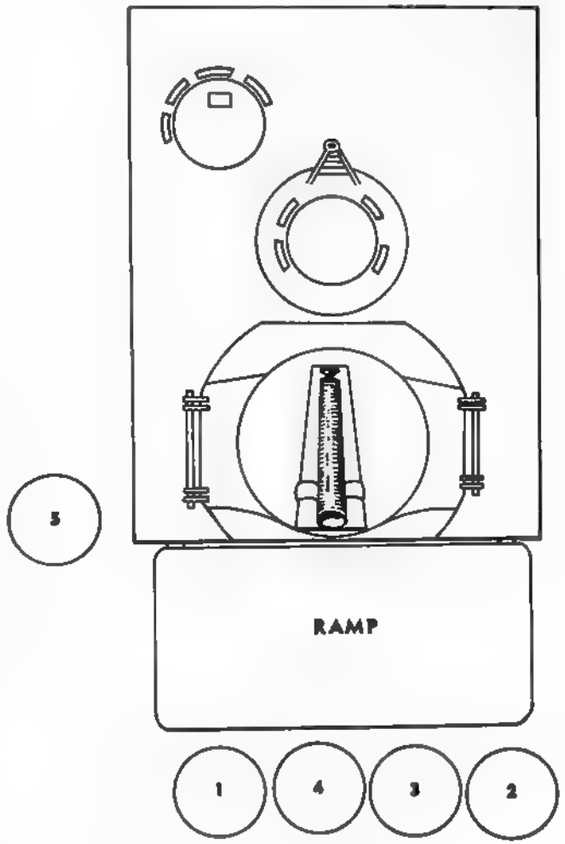


Figure 39. Dismounted positions.

(2) *Mounted.* Positions are indicated in figure 40. The squad leader positions himself to operate the organic communications of the carrier, and maintains contact with the fire direction center and the other two squads of the mortar section. He also closely supervises the actions of the ammunition handler and inspects the ammunition before it is passed to the assistant gunner. The ammunition handler is within easy reach of stowed ammunition and is able to pass ammuni-

tion directly to the assistant gunner without disturbing the mortar or causing the assistant gunner to move. In addition to his normal position in the driver's seat, the driver may also occupy position "A" indicated in figure 40. This position is normally occupied by either the driver or ammunition handler when the mortar is being fired over the front or left side of the carrier. In this manner ammunition stored in the right side of the carrier is readily available and can be passed directly to the assistant gunner. When the mortar is firing in any direction other than over the rear of the carrier, the positions of the gunner and assistant gunner, in relation to the mortar, do not change. They remain in position and the turntable upon which the mortar is mounted (fig 41) is rotated to the desired direction.

93. Vehicle Drill

a. To Form the Squad. The squad forms on the

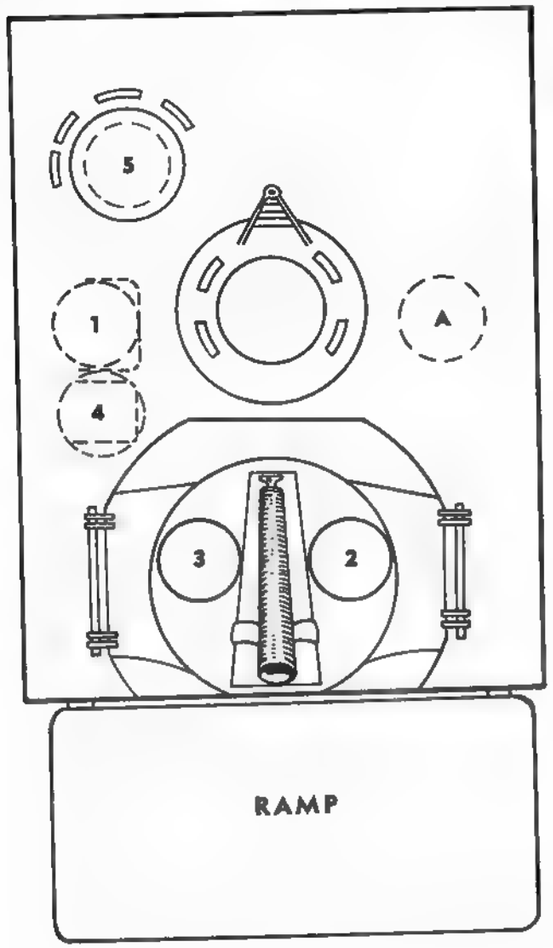


Figure 40. Mounted positions.

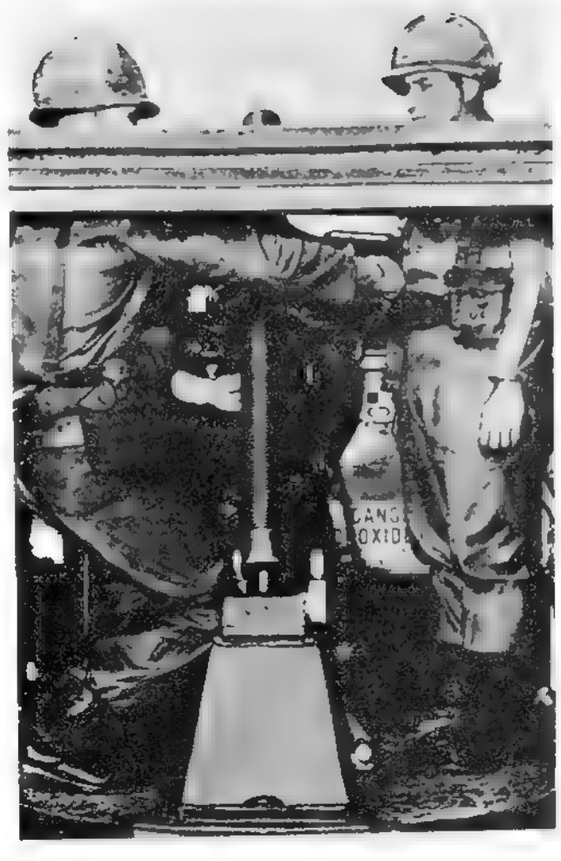


Figure 41. Gunner and assistant gunner positions with mortar firing over front of carrier.

command, FALL IN. All squad members take their dismounted posts (fig 39).

b. To Mount. The squad members assume their mounted positions at the command, PREPARE TO MOUNT, MOUNT.

c. To Dismount. The squad dismounts and assumes dismounted positions at the command, PREPARE TO DISMOUNT, DISMOUNT.

94. Mounted Action

a. Mounted squad drill begins with the squad members already in their respective mounted positions and the mortar in the travel position. The following actions should be practiced with the ramp closed as well as open.

b. Mounted drill in initiated by the squad leader's command of ACTION, or if the mortar is going to be fired in a direction other than over the rear of the carrier, TO YOUR FRONT (LEFT) (RIGHT), ACTION. Each squad member performs the following actions:

(1) The gunner and the assistant gunner—Unlatch and open the mortar hatch covers on top of the carrier.

(2) The gunner—Removes and stows mortar tiedown straps in equipment bag (fig 42).

(3) The gunner and the assistant gunner—Raise the mortar; install and lock the bipod assembly in the center position of the bipod support by turning the locking handle at the base of the bipod (fig 43).

(4) The gunner—Removes the sight extension from its stowed position over the fuze rack attached to the right-hand fuel compartment; installs the sight extension onto the dovetail slot of the bipod assembly; and attaches the sight unit to the sight extension.

(5) The assistant gunner—Removes muzzle cover from the mortar barrel.

(6) The gunner—Elevates the mortar to an elevation of 1100 mils and crosslevels as in ground-mounted operations.

Note. The carrier-mounted mortar does not have a brass adjusting nut for crossleveling as does the ground-mounted mortar. Crossleveling is accomplished by operation of the CROSSLEVELING HANDWHEEL CENTERED ON THE LEFT LOG OF THE BIPOD ASSEMBLY (fig. 43).

c. Concurrent with the actions of the gunner and the assistant gunner, the following actions are performed by the other members of the squad:

(1) The driver and assistant ammunition handler—Insures that the brakes on the carrier are locked.

(2) The driver and assistant ammunition handler—Insures that the hatch cover sections are securely latched in the open position.

(3) The driver and assistant ammunition handler—Ties down antenna with tiedown strap.

(4) The squad leader and/or track commander—Locks the 50 caliber machinegun in travel position.

(5) The squad leader and/or track commander—Traverses the commander's cupola to aline the marks inside the cupola and locks the cupola.

(6) The squad leader and/or track commander—Closes and latches the commander's cupola.

(7) The ammunition handler—Prepares ammunition for firing and stows the prepared ammunition in the "READY" stowage racks next to his position in the carrier. (Ammunition stowed in the "READY" stowage racks is stowed vertically *with fuze up.*)

d. Upon completion of all procedures to place the mortar into action, the remaining squad drill procedures are similar to those with the ground-mounted mortar, with the exceptions noted below.

e. Exceptions include the following:

(1) No settling rounds need be fired.

(2) Large deflection changes are made by first centering the mortar on its traversing mechanism and then rotating the mortar, mount, and turntable until the mortar is pointing approximately along the new deflection. This is accomplished by the following procedure:

(*a*) The assistant gunner—Unlatches the traverse locking handle of the turntable and raises the handle to its forward position (fig 44).

(*b*) The gunner and assistant gunner—Rotate the turntable, mount, and mortar until it is on the approximate deflection as determined by the gunner.

(*c*) The assistant gunner—On command from the gunner pushes down on the traverse locking handle which locks the turntable in position.

(*d*) The gunner—Traverses and levels the mortar, using the traversing handwheel and crossleveling handwheel until the sight is again on the aiming posts and set at the exact deflection.

f. Squad drill procedures are reversed in taking the mortar out of action and preparing the mortar and carrier for travel. The squad goes out of action at the squad leader's command OUT OF ACTION.

95. Misfire Procedures

As in the conduct of squad drill with the ground-mounted mortar, misfire procedures may be introduced by the squad leader at any time during crew drill, with the warning of MISFIRE.

a. At the warning of MISFIRE, the driver and ammunition handler leave the carrier. The gunner, assistant gunner, and the squad leader remain.

b. When any doubt exists as to whether the round has struck the firing pin, the gunner, making sure no one is in front of the muzzle of the mortar, strikes the barrel from the rear with the heel of his boot. If the round does not fire and the barrel is hot, allow it to cool. If the barrel is not

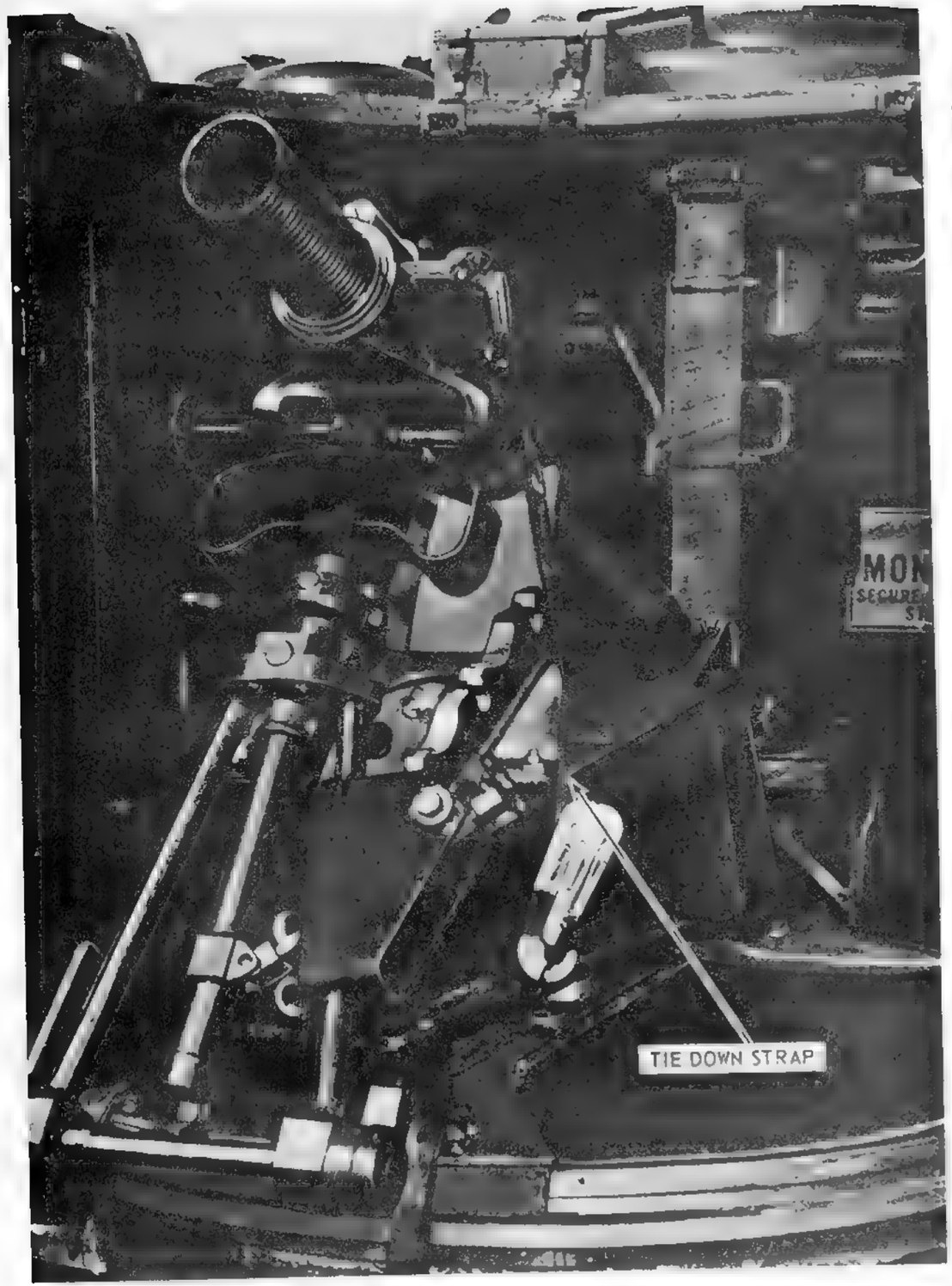


Figure 42. Mortar in travel position with tiedown strap in place.

Figure 43. Mounting the mortar on bipod support.

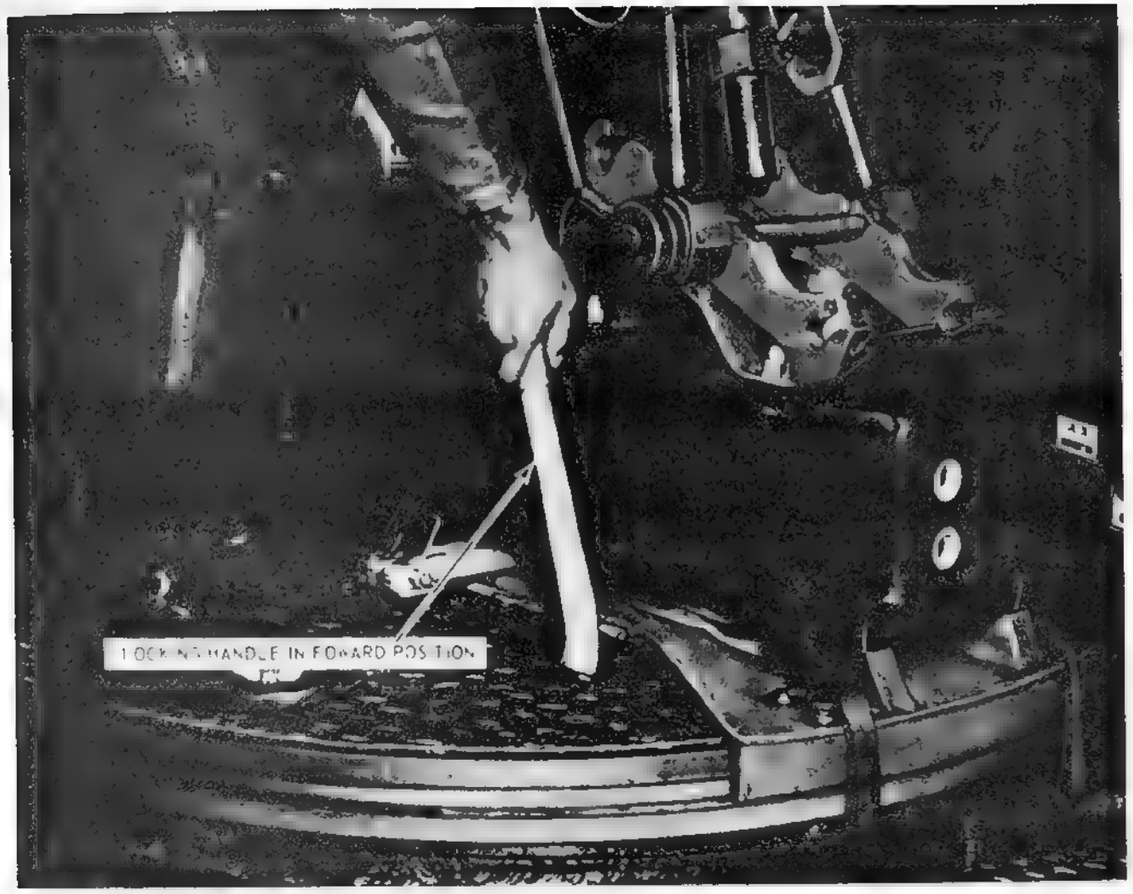


Figure 44. Turntable with traverse locking handle unlocked to allow rotation of the turntable.

hot, the gunner waits 1 minute to preclude the possibility of a hangfire.

c. After the 1-minute waiting period, or after the barrel has cooled so it can be handled with bare hands, the gunner and assistant gunner traverse the turntable until the mortar is approximately centered on the rear of the ramp opening (fig 46).

Note. If the ramp is up during firing and a misfire occurs, the driver remounts the carrier and lowers the ramp after insuring that it is safe to do so.

d. The assistant gunner re-engages the traverse locking handle to insure that the turntable does not move during the removal of the misfire.

e. The gunner depresses the mortar to its lowest elevation. Then elevates the mortar 30 turns on the elevating crank so the barrel will clear the rear roof plate of the carrier when the baseplug end of the mortar is lifted.

f. The gunner removes the sight and sight extension, then without getting behind the mortar, rotates the barrel 1/4-turn to unlock the baseplug from the mortar socket.

g. The assistant gunner, standing to the right of the mortar, places his right hand under the barrel near the muzzle and his left hand on top of the barrel, making certain that no part of either hand extends over the rim of the muzzle.

h. The gunner places his right hand around the baseplug end of the barrel and his left hand on the upper portion of the bipod assembly. He carefully lifts the baseplug end of the barrel to a horizontal position, at the same time pulling back on the bipod assembly to insure clearance between the muzzle and the roof plate of the carrier (fig 46).

Note. The gunner insures that the baseplug end of the barrel will clear the roof plate of the carrier at the forward edge of the mortar hatch opening.

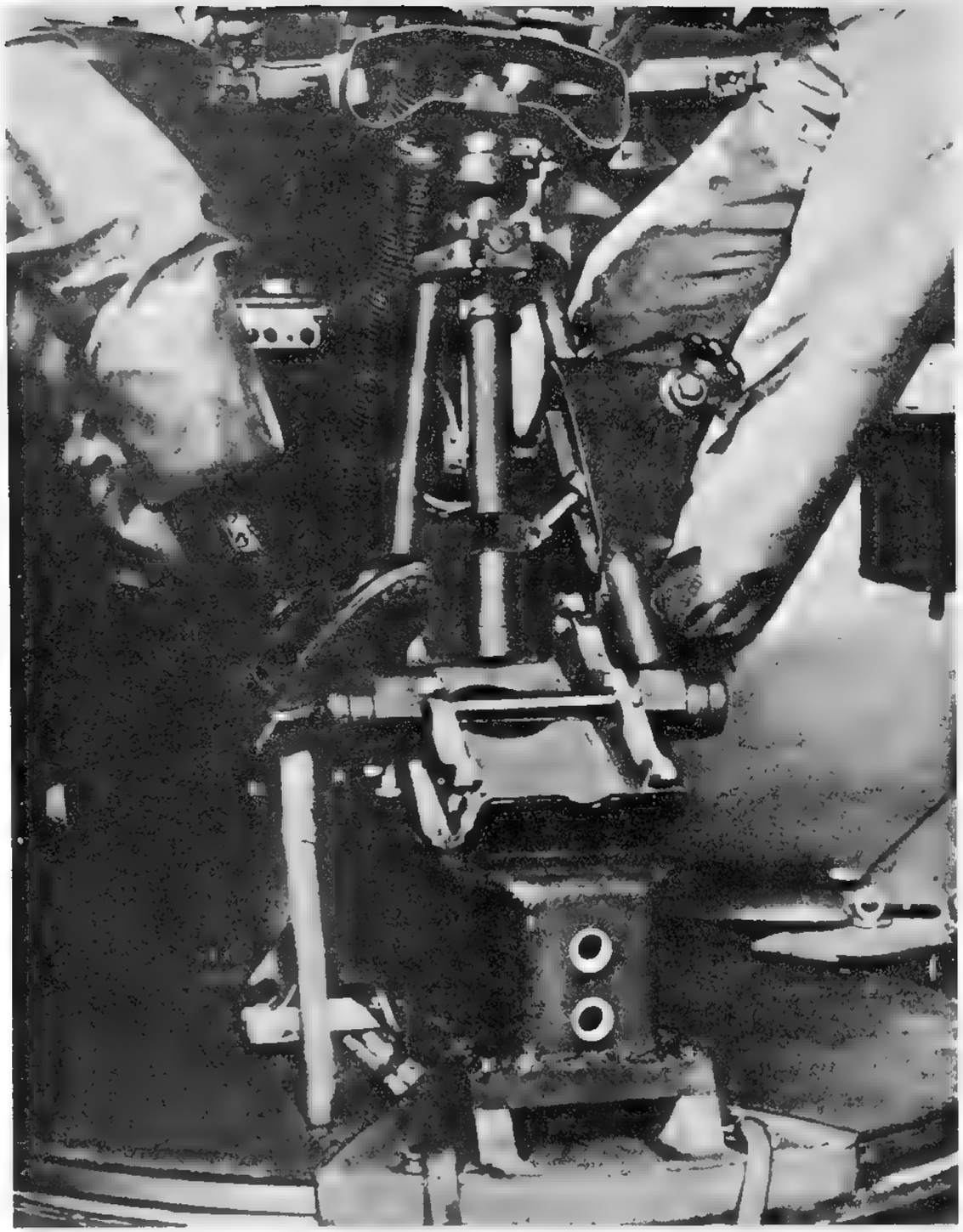


Figure 45. Gunner and assistant gunner rotating the turntable.

i. As the barrel reaches the horizontal, the assistant gunner extends the thumbs of both hands over the muzzle to stop the round at the muzzle without touching the fuze. The gunner continues to raise the baseplug end of the barrel until the round reaches the muzzle and is removed by the assistant gunner. The assistant gunner follows the same procedure as in ground-mounted operations for refiring or, as required, for disposing of the round.

Note. Do not remove the bipod from the bipod mount at any time during removal of a misfire.

j. With the baseplug end of the barrel still in the raised position, the gunner shakes the barrel to dislodge and remove any foreign material. The barrel is then placed back into the mortar socket and the assistant gunner swabs the bore.

Note. If a misfire cannot be removed from the barrel then remove the barrel from the mount and place it outside the carrier in the horizontal position facing the direction of fire.

k. The mortar is relaid on last data given by the squad leader and squad drill continues.

96. Section Drill

a. Since the section consists of three squads and the fire direction center, all mounted in carriers, training of all squads of the mortar section under the control of the fire direction center must be conducted.

b. At the command PREPARE FOR ACTION, the carriers with mortar squads mounted are halted and engines are left running until the section leader is in position with the aiming circle and indicating the general direction of fire, using normal arm-and-hand signals.

c. The base mortar squad selects by observation the approximate center of the section position and moves the carrier to that position, alining the carrier in the general direction of fire. The other two squads then move into position alined on the base squad carrier. (Engines are left running and ramps are lowered to the horizontal position.)

Note. At the command PREPARE FOR ACTION all three squads go through the normal squad crew drill procedures for placing the mortar into action as outlined in paragraph 94.

d. When all squads are in position, the ammunition handler from each squad removes the aiming posts from the cover and moves to a position between the section leader and the carrier to act as relay man (for voice commands) during reciprocal lay.

e. The squad leader notes when his squad is ready and signals SQUAD NO. , SQUAD READY TO BE LAID.

f. Reciprocal laying of the carrier mounted section is essentially the same as in ground-mounted operations with this exception: if the first deflection given by the section leader would cause the turntable and mortar to be moved from the center of the indexing gear, the carrier itself is shifted under the direction of the gunner. The turntable is not moved. The ammunition handler from each carrier acts as a relay man to overcome the noise of the carrier engines during exchange of initial deflections.

Figure 46. Roof clearance during removal of misfire.

CHAPTER 4

GUNNER'S EXAMINATION

Section I. PREPARATORY INSTRUCTION

97. General

The gunner's examination is a continuation of crew drill and is the qualification step which tests the proficiency of the gunner. Preparatory training for the gunner's examination is given to the soldier in the course of his mechanical training and crew drill. This training teaches the soldier to perform the duties of the gunner in a prescribed manner. Annual qualification with the gunner's examination will provide a continuous test and record of the gunner's proficiency. The examination includes situations as might occur in actual combat. It not only tests the gunner on his manual skills and duties but requires him to show leadership and organizational abilities in the use of the assistants he is allowed to choose to aid him as he takes the test. The gunner's examination also provides an excellent source of competition. Units should insure that all members of mortar squads take the test, and encourage competition between individuals, squads, and companies. Preparatory training, preparation for the test, and conduct of the gunner's examination must be thorough and unifrm so that results will be valid.

98. Equipment and Training Aids

Instructors should use, but not limit themselves to, equipment authorized in tables of organization and equipment and training aids kits. Simple but effective training aids may be devised to increase the efficiency of instruction. However, training with the actual equipment is normally more effective. Instructors are reminded that learning is accomplished best through the sense of sight, followed by hearing and touch, in that order. The more senses to which the instructor can appeal, the more permanent will be his teaching.

99. Training Notes

a. The applicatory method of instruction is used throughout, supplemented as appropriate with demonstrations, graphic representations, and conference techniques. First, as a part of crew drill training, the conditions and requirements of each step of the qualification course are explained and demonstrated. Then each man is given practical work in each step under the supervision of group instructors. Accuracy is stressed from the start; speed is attained through repetition.

b. The soldier is not given instruction on the gunner's examination until he has become proficient in mechanical training, the appropriate portions of crew drill, and fire commands and their execution.

c. The preparatory exercises of the mortar marksmanship course consists of training in the various subjects of the gunner's examination. Examination in the subjects of the qualification course (gunner's examination) is given after preparatory instruction is completed. If time is available, those initially failing the gunner's examination may continue their training until they qualify on a subsequent test. In the preparatory instruction, record each man's progress on a progress chart as shown in figure 47.

d. Instructors should thoroughly prepare and rehearse material before conducting the training. Care must be taken in briefing assistant instructors to achieve coordination in both sequence of presentation and content of instruction. Trainees who have had previous training or experience should be interviewed and/or tested, and those who are proficient in the subject used as assistant instructors or in some other administrative capacity, thus making the instructor's job easier.

e. Each period should incorporate a logical approach to the material to be taught. Normally, the student learns best when the material progresses from easy to hard or from known to unknown. Previous instruction provides an excellent foundation for succeeding instruction and should be so used when possible. This method gives the additional advantage of continuous review by referring to previous instruction, thus reinforcing the instruction with repetition. Strive for this repetition is an effort to make the habits of training so strong that the individual will react in the same manner in the stress of combat.

f. Instruction which is presented to small groups is more effective than a presentation to a large group. The small group will allow more individual practical exercises, will allow more attention to the training of each individual, and will give the individual more opportunity to take part in discussions on the subject.

g. Instructors should make a continuous analysis of the effectiveness of the instruction.

Section II. CONDUCTING THE GUNNER'S EXAMINATION

100. Examining Board

a. The examining board consists of three or more officers who are qualified mortar instructors. Only one of the board may be a member of the same company as the men being tested. Commanders having special order authority issue the orders to appoint these boards.

b. The president of the board supervises the conduct of the examinations and is the final authority when questions arise during the examinations. The remaining members of the board actually conduct the examination. The board may be organized so that each officer tests all six steps of the gunner's examination. If this method is used, each officer can supervise no more than three mortars, each mortar having an assistant instructor. As a general guide, four men can be tested at one mortar in a 4-hour period using this method. However, the board may be organized on a "county fair" system whereby six officers are used. In this system, each officer will be responsible for one station which will test examinees on one step of the gunner's examination. Using this system, each officer can handle up to five mortars, each mortar having an assistant instructor. Using five mortars per station, approximately 200 men can be tested in a 6-hour period when using the "county fair" system.

101. Gunner's Examination Checklist

a. Personnel.

(1) The number of officers on the board will be determined by the number of stations used for testing the various steps of the gunner's examination; plus the president of the board. Administrative officers may be used to assist in conducting the examination but need not be appointed on orders as members of the board.

(2) Noncommissioned officers (NCOs) with experience and knowledge of the examination should be used as assistant instructors (or grading NCOs). It is advisable to use one NCO per mortar plus those the president of the board requires for administrative duties (scorekeepers or guides).

b. Equipment.

Table 4. Equipment for Conducting Gunner's Test

Station	Phase	Equipment	
		For Candidate	*For Examining Officer*
1	Mounting the mortar	1 Mortar 1 Sight 1 Direction stake 1 Baseplate stake	1 Stopwatch
2	Small deflection and elevation change	1 Mortar 1 Sight 2 Aiming posts	1 Stopwatch
3	Referring the sight and realining aiming posts	1 Mortar 1 Sight 2 Aiming posts	1 Stopwatch
4	Large deflection and elevation change	1 Mortar 1 Sight 2 Aiming posts	1 Stopwatch
5	Reciprocal laying	1 Mortar 1 Sight 1 Direction stake	1 Stopwatch 1 Aiming circle
6	Manipulation for traversing fire	1 Mortar 1 Sight 2 Aiming posts	1 Stopwatch

Name	Station number 1				Station number 2				Station number 3				Station number 4				Station number 5				Station number 6			
Jones, J. R.	X				X				X				X				X				X			
		X				X				X				X				X				X		
	X				X				X				X				X				X			
Little, R. M.	X				X					X			X					X					X	
				X				X				X				X				X				X
Bell, A. G.	X				X				X				X				X				X			
		X				X				X				X				X				X		
			X				X				X				X				X				X	
Ford, H. M.	X				X					X				X				X					X	
		X				X					X			X				X					X	
			X				X				X				X				X				X	
	X				X				X				X				X				X			
		X				X				X				X				X				X		
			X				X				X				X				X				X	
	Fair		Good		Very good				Excellent				Excellent and has instructional ability											

Figure 47. Progress chart.

102. Rules for Conduct of Gunner's Examination

a. The examination is made as uniform as possible for all candidates. The board will insure that no information obtained by a candidate during a particular test is transmitted to any other candidate taking that test under identical conditions, and that no candidate receives the benefit of any sight setting or laying of the mortar left by a previously tested candidate.

b. The scores entered on the scorecard (DA Form 2187–R) for each step of the gunner's examination will be initialed or signed by the officer responsible for conduct of the examination.

c. The candidate selects his authorized assistant.

d. If a candidate fails in any trial through the fault of the examiner or the assistant instructor, or the failure or malfunction of the sight or other equipment used, the board disregards that trial and gives the candidate another trial. In the event of failure through the fault of an assistant, one recheck with a different assistant constitutes the final trial.

e. Each candidate is given the steps in the order in which they appear in paragraph 103.

f. The candidate performs each step of the examination twice.

g. In any test that requires mounting or emplacing the mortar either by the candidate or the board, the surface emplacement is used. No digging, and the rear of the baseplate is not staked.

h. Sight settings are considered correct when any part of the index coincides with any part of the line of graduation of the required setting.

i. The left edges of the aiming posts and direction stake are used for alinement.

j. In any test requiring the candidate to lay for elevation or cross-level the mortar, the board considers the position of the bubble in either the elevation or cross-level vial to be correct if the bubble is between the outer etched lines, or between but touching one of the outer etched lines on the glas tube.

k. When, because of a loose condition, a mortar fails to maintain the lay after a candidate calls UP or FIRE, a member of the board twists the mortar (taking up the play without manipulation) until the cross-level bubble is within the two outer etched lines. He then looks through the sight, and if the vertical line is within 2 mils of the left edge of the posts or stake, the candidate is given full credit for that trial, provided the other conditions are fulfilled correctly.

l. The candidate is permitted to traverse the mortar to the middle point of the traverse before each trail at laying the mortar.

m. Elevations given the candidate by the board will not require him to make more than 20 turns of the elevating crank.

n. In time trails, the candidate does not receive credit for the time trail if he performs any part of it after READY, or the last word of any required announcement.

o. In any case not specifically covered, where the candidate's performance of the test requirements shows that the mortar used will not function satisfactorily if it is fired, the examining board gives no credit for that portion of the test.

p. The board insures no unauthorized assistance is given to the gunner during the examination. The gunner has been trained for combat performance and the test is given with this in mind.

q. When performing the test with the M23A1 baseplate, the baseplate is assembled as one unit and is so employed throughout the qualification course.

r. The candidate must repeat all fire commands.

s. Each candidate is given one trail run on each step.

t. For his test run, the candidate should be given one fire command in even numbers (deflection 2780, elevation 1180) and one fire command in odd numbers (deflection 2785, elevation 1135) at appropriate stations.

103. Gunner's Examination

a. Examination Subjects

		Value
(1)	Mounting the mortar	40
(2)	Small deflection and elevation change	80
(3)	Referring the sight and re-alining aiming posts	80
(4)	Large deflection and elevation change	40
(5)	Reciprocal laying	80
(6)	Manipulation for traversing fire	80
	Total possible credits	200

b. Qualification Score.

	Score	Percent
Expert gunner	180	90
1st class gunner	160	80
2d class gunner	140	70
Unqualified: less than	140	70

c. Qualification/Familiarization Course. The examination is divided into six steps as described below. Each step is run twice. Each candidate carries his scorecard (DA Form 2187–R, 1, Fig 48) from station to station. DA Form 2187–R will be reproduced locally on 3 1/2- x 8-inch paper (2, fig 48). The officer at each station makes appropriate entries in ink or indelible pencil on the candidates' scorecards as they complete the requirement(s) of the station. This course is for qualification or familiarization.

d. Step 1. Mounting the Mortar.

(1) *Conditions.*

(*a*) Two stakes are placed at least 25 meters apart. One is designated as the baseplate stake and the other as a direction stake.

(*b*) The baseplate, mount, and the mortar barrel are laid out 10 meters behind the baseplate stake. The sight, in a closed and latched case, is placed approximately 2 feet to the left of the baseplate stake. Each candidate is allowed two assistants to perform the duties of Nos. 2 and 3 men.

(2) *Procedures.*

(*a*) The candidate executes the premounting checks of the mount to see that—

1. The spread chain is doubled, wrapped around the legs, and hooked to the left leg but not entangled or binding.

2. The clearance on the left leg below the sleeve or above the adjusting nut is two fingers in width.

3. The locking sleeve is neither too loose nor too tight.

4. The traversing bearing is centered.

5. The clevis locking pin is fully seated.

(*b*) No. 2 checks to see that the barrel ring is approximately centered between the two white lines.

(*c*) When the candidate is ready to receive the order, the testing officer commands TO YOUR FRONT, ACTION.

(*d*) At this command, Nos. 3, 1, and 2 move rapidly in the order named to the baseplate stake. The mortar is mounted and laid on the line established by the baseplate stake and the direction stake. The candidate performs the duties of the gunner. As soon as the mortar is mounted and laid with sight settings of 0 mils deflection and 1100 mils elevation, the candidate calls UP.

(*e*) Time is taken from the command ACTION to the candidate's announcement UP.

(*f*) Nos. 2 and 3 men may visually aline the mortar using the sight bracket while the candidate removes the sight unit from the sight case.

(*g*) The candidate must initially tighten the locking nut. The No. 2 man may loosen and retighten the locking nut to correct any deficiencies.

(3) *Scoring.*

(*a*) No credit is given when the—

1. Time exceeds 90 seconds.

2. Sight is not set correctly for deflection (0) and elevation (1100).

3. Mortar is not correctly laid for elevation (the elevation bubble is not centered).

4. Mortar is not cross-leveled.

5. Vertical line of the sight is more than 2 mils off the left edge of the direction stake.

6. Traversing mechanism is more than two turns to the left or right of the center position.

7. Barrel is not locked to the baseplate.

8. Baseplate is not positioned correctly in relation to the baseplate stake.

(*b*) When the mortar is laid correctly within the prescribed limits, credit is given as follows:

Time in seconds	65 or Less	66–70	71–75	76–80	81–85	86–90
Credits	20	18	16	14	12	10

Total possible score (two trials) ..... 40.

e. Step 2. Small Deflection and Elevation Change.

(1) *Conditions.*

(*a*) The mortar is mounted with two aiming posts set out the normal distance on a referred deflection of 2800 mils. The mortar is laid on the posts with a deflection of 2800 and the traversing bearing centered. The elevation scale is set at 1100 mils and the elevation and cross-level bubbles are centered.

(*b*) The deflection change must be less than 60 mils and more than 20 mils. The elevation change announced must be less than 90 mils and more than 35 mils.

(*c*) For each trial the candidate takes the gunner's position on the left of the mortar and makes the necessary preliminary checks ((*a*) above).

(*d*) The candidate may start this step with his hand on the deflection knob of the sight.

(2) *Procedure.*

(*a*) When the candidate is ready, the testing officer announces an initial fire command; for example, NUMBER ONE, HE QUICK, ONE ROUND, DEFLECTION TWO EIGHT FIVE FIVE, CHARGE TWO, ELEVATION ONE ONE SEVEN FIVE.

(*b*) The candidate repeats each element of the command, sets the sight with the data as announced, lays the mortar for elevation, and re-

GUNNER'S EXAMINATION 81-mm MORTAR
For use of this form, see FM 23-90; the proponent agency is U.S. Continental Army Command

NAME (Last, first, middle initial): JONES, JOHN R — GRADE: PFC
DATE: 15 FEB 72 — UNIT: CO A

STEPS		TIME	POINTS	SCORE
MOUNTING MORTAR	1	65	20	40
	2	65	20	2BB
SMALL DEFLECTION & ELEVATION CHANGE	1	20	15	30
	2	20	15	RX
REFERRING THE SIGHT & REALINING AIMING POSTS	1	45	15	30
	2	45	15	JRH
LARGE DEFLECTION & ELEVATION CHANGE	1	30	20	40
	2	30	20	WMB
RECIPROCAL LAYING	1	65	15	30
	2	65	15	BOP
MANIPULATION FOR TRAVERSING FIRE	1	50	15	30
	2	50	15	gbg
TOTAL SCORE				200

QUALIFICATION SCORES

EXPERT GUNNER	180-200
1ST CLASS GUNNER	160-179
2ND CLASS GUNNER	140-159
UNQUALIFIED	0-139

QUALIFICATION: EXPERT
VERIFIED BY: C.C. Graham, Capt. Inf

DA FORM 1 FEB 72 2187-R — PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE.

1. Sample filled-in copy of DA Form 2187–R

GUNNER'S EXAMINATION 81-mm MORTAR
For use of this form, see FM 23-90; the proponent agency is U.S. Continental Army Command

NAME (Last, first, middle initial) — GRADE
DATE — UNIT

STEPS		TIME	POINTS	SCORE
MOUNTING MORTAR	1			
	2			
SMALL DEFLECTION & ELEVATION CHANGE	1			
	2			
REFERRING THE SIGHT & REALINING AIMING POSTS	1			
	2			
LARGE DEFLECTION & ELEVATION CHANGE	1			
	2			
RECIPROCAL LAYING	1			
	2			
MANIPULATION FOR TRAVERSING FIRE	1			
	2			
TOTAL SCORE				

QUALIFICATION SCORES

EXPERT GUNNER	180-200
1ST CLASS GUNNER	160-179
2ND CLASS GUNNER	140-159
UNQUALIFIED	0-139

QUALIFICATION
VERIFIED BY

DA FORM 1 FEB 72 2187-R — PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE.

2. Reproducible copy of DA Form 2187–R

Figure 48. Scorecard for gunner's examination.

BY

lays with the proper sight picture, cross-leveling simultaneously. As soon as the mortar is laid, he commands FIRE.

(*c*) Time is taken from the announcement of the elevation element of the fire command to the command FIRE by the candidate.

(3) *Scoring.*

(*a*) No credit is given when the—

1. Time exceeds 35 seconds.

2. Sight is not set correctly for deflection or elevation.

3. Mortar is not correctly laid for elevation.

4. Mortar is not cross-leveled.

5. Vertical line of the sight is more than 2 mils off the left edge of the aiming posts.

(*b*) When the mortar is laid correctly within the prescribed limits, credit is given as follows:

Time in seconds	20 or less	21–23	24–26	27–29	30–32	33–35
Credits	15	13	11	9	7	5

Total possible score (two trials) ..... 30.

f. Step 3. Referring the Sight and Realining Aiming Posts.

(1) *Conditions.*

(*a*) The mortar is mounted with the two aiming posts positioned at the normal distance from the mortar position. The candidate receives an administrative fire command with a deflection between 2860 and 2740 mils, which causes the mortar's fire to be adjusted back into sheaf (for example NUMBER ONE, DEFLECTION TWO EIGHT ONE ZERO, ELEVATION ELEVEN HUNDRED). The mortar is then relaid on the aiming posts, using the traversing handwheel. (This causes the traversing bearing to go off center.) The elevation scale is set at 1100 mils and the elevation and cross-level bubbles are centered.

(*b*) The candidate checks the conditions set forth above before each trial.

(*c*) The change in deflection in the fire command must be less than 25 mils and greater than 5 mils.

(*d*) The candidate is allowed two assistants, one to place out aiming posts and one to move the bipod legs.

(2) *Procedure.*

(*a*) When the candidate is ready, he is given a fire command; for example, DEFLECTION TWO SEVEN EIGHT ZERO, REFER, REALINE AIMING POSTS.

(*b*) The candidate repeats each element of the fire command, sets the sight with the data given in the fire command, and directs one assistant in realining the aiming posts. (Once this has been accomplished, the candidate will center his traversing mechanism and with the assistance of the No. 2 man moves the bipod legs and re-lays on the aiming posts.) After he lays the mortar on the realined posts, he announces UP. This procedure insures that for a following fire mission the mortar has full traversing capabilities both right and left.

(*c*) Time is taken from the announcement of the last word of the deflection element to the candidate's announcement of UP.

(3) *Scoring.*

(*a*) No credit is given when the—

1. Time exceeds 75 seconds.

2. Traversing handwheel is turned before the aiming posts are realined.

3. Sight is not set correctly for deflection or elevation.

4. Vertical line of the sight is more than 2 mils off the left edge of the aiming posts.

5. Traversing mechanism is more than two turns to the left or right of the center position.

6. Mortar is not correctly laid for elevation.

7. Mortar is not cross-leveled.

(*b*) When the mortar is laid correctly within the prescribed limits, credit is given as follows:

Time in seconds	60 or Less	61–63	64–66	67–69	70–72	73–75
Credits	15	13	11	9	7	5

Total possible score (two trials) ..... 30.

g. Step 4. Large Deflection and Elevation Change.

(1) *Conditions.*

(*a*) Two aiming posts are placed at the normal distance from the mortar position on a referred deflection of 2800 mils. The mortar is laid on the aiming posts with deflection 2800 and elevation 1100. The traversing bearing is within two turns of center.

(*b*) The candidate is allowed to choose one assistant whose duty is to assist in moving the bipod legs.

(*c*) The candidate is in the gunner's position and is allowed to have his left hand on the deflection knob.

(*d*) The change in elevation announced must be less than 200 mils and greater than 100 mils.

(*e*) The change in deflection announced must be greater than 200 mils and less than 300 mils.

(2) *Procedure.*

(*a*) When the candidate is ready, he is given a fire command; for example, NUMBER ONE, HE QUICK, ONE ROUND, DEFLECTION THREE, ZERO FOUR FIVE, CHARGE TWO, ELEVATION ONE TWO ONE FIVE.

(*b*) The candidate repeats each element of the fire command, and relays on the aiming point with a compensated sight picture. As soon as the mortar is laid, he commands FIRE.

(*c*) For the second trial, a different deflection and elevation is given.

(*d*) Time is taken from the elevation element of the fire command to the command FIRE by the candidate.

(3) *Scoring.*

(*a*) No credit is given when the—

1. Time exceeds 60 seconds.

2. Sight is not set correctly for deflection or elevation.

3. Mortar is not correctly laid for elevation.

4. Mortar is not cross-leveled.

5. Vertical line is more than 2 mils off the compensated sight picture.

6. Traversing mechanism is more than two turns to the left or right of the center position.

(*b*) When the mortar is laid correctly within the prescribed limits, credit is given as follows:

Time in seconds	35 or Less	36–40	41–45	46–50	51–55	56–60
Credits	20	18	16	14	12	10

Total possible score (two trials) ..... 40.

h. Step 5. Reciprocal Laying.

(1) *Conditions.*

(*a*) The mortar is mounted on an initial azimuth by the examining board. The candidate is given one assistant to shift the bipod legs.

(*b*) The mortar is mounted for the candidate with the sight at zero deflection and 1100 mils elevation, and is laid on a direction stake on the initial azimuth. The traversing mechanism is centered.

(*c*) The azimuth on which the candidate is ordered to lay the mortar is not less than 150 mils nor more than 200 mils away from the initial azimuth.

(*d*) The examining officer sets up the aiming circle approximately 25 meters from the mortar with the head of the instrument leveled and the 0–3200 line already laid on the azimuth on which the mortar is to be laid. If aiming circles are not available, a mortar equipped with an M34 or M53 sight unit may be substituted.

(*e*) The candidate is allowed to start the test with his hand on the deflection knob of the sight.

(2) *Procedure.*

(*a*) A qualified aiming circle operator operates the aiming circle.

(*b*) He announces to the mortar, AIMING POINT THIS INSTRUMENT.

(*c*) The candidate refers the sight to the aiming circle and replies AIMING POINT IDENTIFIED.

(*d*) The examining officer then announces the deflection; for example, NUMBER ONE, DEFLECTION TWO THREE ONE FIVE.

(*e*) The candidate repeats the announced deflection, sets it on his sight, and lays the mortar on the center of the head of the aiming circle. He then announces NUMBER ONE, READY FOR RECHECK.

(*f*) When the candidate announces NUMBER ONE, READY FOR RECHECK, the examining officer announces the new deflection immediately so that there is no unnecessary delay.

(*g*) The operation is completed when the candidate announces NUMBER ONE, ZERO (OR ONE) MIL(S), MORTAR LAID.

(*h*) Time is taken from the first announced deflection by the examining officer until the candidate announces NUMBER ONE, ZERO (or ONE) MILS, MORTAR LAID.

(3) *Scoring.*

(*a*) No credit is given when the—

1. Time taken exceeds 1 minute, 55 seconds.

2. Sight is not set correctly for deflection.

3. Elevation bubble is not centered.

4. Cross-level assembly bubble is not centered.

5. Vertical line of sight is more than 1 mil off the center of the head of the aiming circle.

(*b*) When the mortar is laid correctly within the prescribed limits, credit is given as follows:

Time in seconds	65 or Less	66–70	71–75	76–80	81–85	86–90	91–95	96–100	101–105	106–110	111–115
Credits	15	14	13	12	11	10	9	8	7	6	5

Total possible score (two trials) ..... 30.

i. Step 6. Manipulation for Traversing Fire.

(1) *Conditions.*

(*a*) The mortar is mounted with deflection 2800 mils and elevation 1100 mils on the sight and laid on the aiming posts with the traversing bearing centered.

(*b*) When the mortar has been laid, the candidate is given the command PREPARE TO TRAVERSE RIGHT (LEFT). The candidate traverses the mortar left (right) until the traversing bearing is stopped by the yoke assembly. He then backs off two turns. He does not re-lay on the aiming posts until the fire command is issued.

(*c*) No deflection change is given.

(*d*) The number of rounds specified must be four.

(*e*) The amount of traverse between rounds must be two or three turns.

(*f*) The elevation change announced must be less than 90 mils and greater than 30 mils.

(*g*) The candidate is allowed an assistant to shift the bipod.

(2) *Procedure.*

(*a*) When the candidate is ready, he is given a fire command; for example, FOUR ROUNDS, TRAVERSE RIGHT THREE TURNS, CHARGE TWO, ELEVATION ONE ONE SEVEN FIVE.

(*b*) The candidate repeats each element of the command, sets the sight, and lays the mortar on the aiming posts with the aid of his assistant, who shifts the bipod legs. When the candidate has the mortar laid, he commands FIRE ONE, traverses the specified number of turns, cross-levels at the same time, and commands FIRE TWO; traverses, cross-levels, and commands FIRE THREE; traverses, cross-levels, and commands FIRE FOUR.

(*c*) Time is taken from the elevation element of the fire command to the command FIRE FOUR by the candidate.

(3) *Scoring.*

(*a*) No credit is given when the—

1. Time exceeds 80 seconds.

2. Candidate fails to command FIRE for each round.

3. Sight is not set correctly for elevation.

4. Candidate does not cross-level before firing each round.

5. Mortar is not cross-leveled after firing the last round.

6. Mortar is laid in error more than 20 mils. The amount of the error is checked by the testing officer by traversing back and cross-leveling the total number of turns indicated by the fire command. For example, if the command given is 3 turns (and four rounds) the total number of turns taken by the candidate should be 9. Therefore, the mortar is traversed back 9 turns, cross-leveled, and checked to determine the number of mils the vertical line is off the left edge of the aiming posts.

(*b*) When the mission has been fired correctly within the prescribed limits, credit is given as follows:

Error in mils	0–4	5–8	9–12	13–16	17–20
Credits	15	13	11	0	7

Time in seconds	50 or Less	51–60	61–70	71–80
Points cut according to time used for requirement	0	2	4	6

The score is computed by giving credit according to mil error and then cutting points appropriate to the time a candidate uses for the requirement (example: 7-mil error in 60 seconds equals 13 points credit minus 2 points cut for time; or, 11 points in that trial).

Total possible score (two trials) ..... 30.

CHAPTER 5

TACTICAL CONSIDERATIONS IN THE EMPLOYMENT OF THE 81-MM MORTAR SECTION

Section I. EMPLOYMENT

104. General

The mortar section provides close and continuous indirect fire support to the company. In the defense it provides fires on long-range targets in support of the COP (if appropriate); fires within the battle area; close defensive fires; and final protective fires (FPF). Harassing and interdictory (H & I) fires may be fired. In the offense, it fires preparatory fires and fires in support of the scheme of maneuver.

105. Selection of Mortar Positions

Based on the general location directed by the company commander, the section leader normally selects the general position for each squad, leaving the selection of the exact site to the squad leader. Usually the three squads are located in one firing position under control of the FDC. In selecting the firing position, the section leader concurrently considers the following—

a. Maximum Coverage for the Company Area. The section should be located near the center of the company sector to permit maximum coverage of the company. It should be located as far forward as situation and terrain permit in order to take advantage of maximum range. The section is located far enough behind the FEBA to provide fires within the battle area and support the reserve platoon in a counterattack role or support the reserve when it is used as a blocking force.

b. Cover and Concealment. The section should be located in defilade to protect it from direct fire weapons. Proper use of camouflage will deny ground and aerial observation.

c. Mask and Overhead Clearance. The section should be located far enough to the rear of any hill mass so that the mortars are not limited in their ability to depress the barrel to minimum elevation (maximum range). Camouflage is desirable, yet, due to the high angle of fire, overhead clearance is necessary and this may require the trimming of tree limbs.

d. Dispersion Between Squads. The mortar position should allow 30 to 35 meters of lateral dispersion between squads. This will allow the section to fire a parallel sheaf approximately 100 meters wide.

e. Firm Ground and Access Roads. The position should be in a well-drained area, with soil conditions that will support vehicle movement and prevent excessive settling of the base plates. There should also be access roads near the position. These roads will enable the section to move in and out of position rapidly.

f. Security. The section has a limited capability for securing the firing position. Additional security is gained by positioning near the reserve platoon in the defense and remaining with or as close to the main body as possible during movement.

106. Organization of the Firing Position

As the squads of the section arrive at their assigned areas, each squad leader places his squad in a temporary firing position and begins construction of the primary position for the squad as directed by the section leader.

a. Primary Positions. The squad positions should be 35 to 40 meters apart and staggered. The position should be alined so that a parallel sheaf is parallel to the FEBA. The squad occupies the primary positions as soon as possible.

b. Alternate and Supplementary Positions. Alternate and supplementary positions should be prepared and showed to each member of the section.

c. Routes of Displacement. Reconnaissance

should be conducted for routes of displacement and anticipated firing positions along these routes.

107. Methods of Employment

a. General Support. General support requires that the section provide support to all or a major portion of the company. The company commander retains overall control of the fires and movement of the section. He designates priority of fires, initial target areas, and general emplacement areas, and he controls displacement. He controls the section through the platoon leader and section leader. The section leader selects firing positions, controls fire and displacement, and insures that the section is resupplied. The desirable characteristics of general support include flexibility in massing and shifting fires, continuity of support, ease of control, and simplicity of resupply.

b. Direct Support. When a fire support element (the entire mortar section, one squad, or any combination of squads) is in direct support of a unit, it is responsible for delivering its fire in support of that unit. When the supported unit does not require fires, the fire support element may fill other fire requests. The direct support unit leader selects firing positions and controls displacement. Direct support is seldom employed at rifle company level.

c. Attachment. When one unit is attached to another, its control, tactical employment, and the responsibility for its combat service support pass from the parent unit commander to the unit that receives the attachment. When elements are attached to the rifle platoon, the platoon leader may use them in general or direct support or he may further attach them to rifle squads.

108. Perimeter Defense

In conducting a perimeter defense, the minimum range of the mortar may dictate the positioning of the mortar squads. The section must be positioned so as to effectively engage its assigned final protective fire or fires. Usually these fires are in a complete circle. The mortar section may be employed in a triangle configuration when in perimeter defense.

Section II. DEPLOYMENT

109. Displacement

a. General. Displacement is by vehicle when the terrain, enemy situation, and availability of vehicles will permit.

b. Three Echelons. This method is used when time is available since it permits two squads to be continually in position, ready to fire. One squad displaces with enough men and equipment to establish a new FDC. The second squad begins displacement when the first squad is ready to fire. The third squad displaces when the second squad is ready to fire.

c. Two Echelons. When displacement is begun while fire missions are numerous, only one squad displaces initially; when there are limited fire missions, two squads can be displaced initially. In either case, enough men accompany the initial echelon to establish a new FDC. This method is faster than displacement by three echelons and still enables the mortars to provide continuous fire support.

d. One Echelon. This method involves the displacement of the entire section at one time. This is the least desirable method of displacement because it does not permit the mortars to provide continuous fire support. It should not be utilized unless adequate artillery and/or additional mortar support is assured.

110. Fire Without an FDC During Movement

a. Fire without an FDC lends itself to such operations as voluntary and involuntary withdrawals, delaying actions, and movement to contact. During these operations, the mortar squads are frequently attached to the forward elements of the company. This method of employment permits immediate response to the supported unit, faster engagement of targets, speeds displacement, and requires minimum mortar personnel and equipment at the point of contact.

b. Delaying Actions. If the mortar squad(s) are attached to the forward element of the company, fire without an FDC should be considered as it will, in most terrain, enable the mortar element to engage targets as soon as observed.

c. Withdrawals. When conducting a withdrawal under enemy pressure, the commander will usually displace the mortar section by two echelons in order to provide continuous fire support to the company. The second echelon in such a displacement can provide support to the company, using fire without a fire direction center. This will free FDC personnel to control the fires of the first echelon which may have to provide supporting fires at long ranges.

d. Movement to Contact. When conducting a movement to contact, fire without an FDC can speed the neutralization of enemy positions within the company's area, and help maintain the momentum of the movement.

CHAPTER 6

CONDUCT OF FIRE, 81-MM MORTAR

Section I. FIRE PROCEDURES

111. Fire With a Fire Direction Center

a. Normally, mortars are employed in defilade in the indirect fire role. In this role the mortar squads can neither see nor be seen by the enemy; this prevents the enemy from easily locating or engaging them with direct fire weapons. Therefore, the squads can be emplaced and laid as a section, using the aiming circle, M2 compass, or sight units. Ammunition resupply can be centralized and ammunition stockpiled, and a heavy volume of fire can be placed on any target the section engages. To exploit this capability, the FDC uses the target-grid method of fire control, which simplifies the procedure for controlling mortar fire. Another advantage to this method is the FDC does not need to know the forward observer's location (except polar plot missions) which allows him freedom of movement and the ability to call for and mass fires on any target within range of the mortars. The FDC applies the target-grid method of fire control by using the M16 or M17 plotting board.

b. The mortar is used in a direct fire role in emergency situations only. An example of such a situation is the direct lay method of fire without a fire direction center.

c. For information on the fire control equipment and techniques used with the target-grid method, see FM 23–91.

112. Fire Procedures Without an FDC

Under certain conditions, it may be impossible or undesirable to use the target-grid method of fire control to place fire on a target. Communications failure, casualties from enemy fire, lack of equipment, or the tactical situation all may require that one or more of the mortars be employed without an FDC.

a. When the squads are under squad control, the FO or the squad leader observes the target area and adjusts and controls the fire by commands that are sent directly to the mortar crew.

b. Employment of the mortars without an FDC is a temporary measure only. The FDC should be established as soon as possible.

c. Advantages of operating without an FDC include:

(1) Speed in engaging a target.

(2) Better response to commanders.

(3) Reduced requirements for personnel and equipment.

d. Disadvantages of operating without an FDC include:

(1) The limited movement capability of the FO.

(2) The difficulty of massing or shifting fires on all targets within the range of the mortar.

(3) The necessity of locating the mortar position too far forward, where it is subject to enemy fire delivered on the friendly frontlines.

(4) Ammunition resupply problems are amplified.

113. Firing Data

a. The mortar can be laid for direction using any of the methods found in chapter 2, section I. Normally the direction-alinement or direct-lay methods are used.

b. Initial range may be determined by:

(1) Estimation by eye.

(2) Map, photo map, or aerial photograph.

(3) Intersection.

114. Corrections by the Observer

a. General. In fire without an FDC the observer makes corrections differently than when operating with a fire direction center. He makes all his deviation corrections with respect to the gun-target line rather than with respect to the observer-target line. All deviation corrections are sent in mils or turns of the traversing handwheel.

b. Observer Within 100 Meters of the Mortar Position. The best location for the observer for rapid fire adjustment is at the mortar position where his deviation spotting and deflection correction in mils, to be placed on the mortar sight, are the same. The tactical employment of the mortar usually makes it necessary for the observer to be in a position other than at the mortar; however, if the observer is located within 100 meters of the mortar position, the deviation error that he reads in his binoculars can be applied directly to the sight without any computations. This is true because the angle that exists between the observer-burst line and observer-target line is, for all practical purposes, equal to the angle that exists between the mortar-burst and the gun-target lines. Any slight difference between these two angles is compensated for by the inherent dispersion of the weapon and the bursting area of the round. For example, if the observer, from a position within 100 meters of the mortar location, observes the burst to the left of the target and reads that it is 40 mils left on the mil scale of his binoculars, he orders a correction of RIGHT FOUR ZERO. This correction is sent to the mortar in mils, and is not converted to meters. The gunner applies this correction directly to the previous deflection setting using the LARS (left add, right subtract) rule.

c. Observer More than 100 Meters From the Mortar Position. It is not always possible for the observer to be located within 100 meters of the mortar position. When he cannot locate himself within 100 meters of the mortar position he must locate himself within 100 meters of the gun-target line. It can be readily seen that this might present some difficulty in visualizing the gun-target line, and getting within 100 meters of it. If the observer is attacking targets over a wide frontage, he would be required to move frequently and his movement would be limited. In this situation, the angle that exists between the mortar-burst and the gun-target line is not equal to the angle that exists between the observer-burst and the observer-target line, and certain computations must be made to correct the differences in these angles. For example, if the observer is halfway between the mortar and the target, the correction to be made on the sight will be one-half his deviation spotting; if the mortar is half-way between the observer and the target, the correction will be twice his deviation spotting. As other distances give other ratios, it is necessary to apply a correction factor to the number of mils spotted before ordering a deflection change. This factor is a fraction, the numerator of which is the observer-target distance, and the denominator of which is the gun-target distance; that is—

$$\text{Correction factor is } \frac{\text{observer-target distance}}{\text{gun-target distance}} \text{ or } \frac{OT}{GT}$$

For example, if the distance from the observer to the target is 1,000 meters, and the gun-target distance is 1,200 meters, and the deviation of the burst from the target as read by the observer is 60 mils (fig 49) the correction is—

$$\frac{1{,}000}{1{,}200} \text{ (or } 5/6) \times 60 \text{ mils} = 50 \text{ mils}$$

In applying this factor, simplicity and speed are important, and the distances used should be to the nearest 100 meters.

115. Fire Commands, General

a. Origin. Fire commands originate with the computer at the FDC or, when the mortars are employed without an FDC, with the leader at the observation post. These commands contain the technical instructions which enable the gunners to lay the mortars for deflection and elevation.

b. Transmission. It is often desirable to transmit fire commands in fragmentary form as the elements of the command are determined. When transmitted in this manner the command can be executed while it is being issued. Whenever practicable, fire commands are given orally. When voice commands are not practicable, telephone or radio may be used. The gunners repeat the elements of every fire command as they receive them.

c. Types. Fire commands are of two types: initial fire commands and subsequent fire commands. The elements of both follow a definite sequence. However, subsequent commands include only such elements as are changed, except that elevation is always announced.

116. Initial Fire Commands

Inital fire commands contain the necessary data to lay the mortars and fire the first round. The sequence for transmission of the initial fire command is:

a. Mortars to follow.

b. Type of projectile and fuze.

c. Mortars to fire.

d. Method of fire.

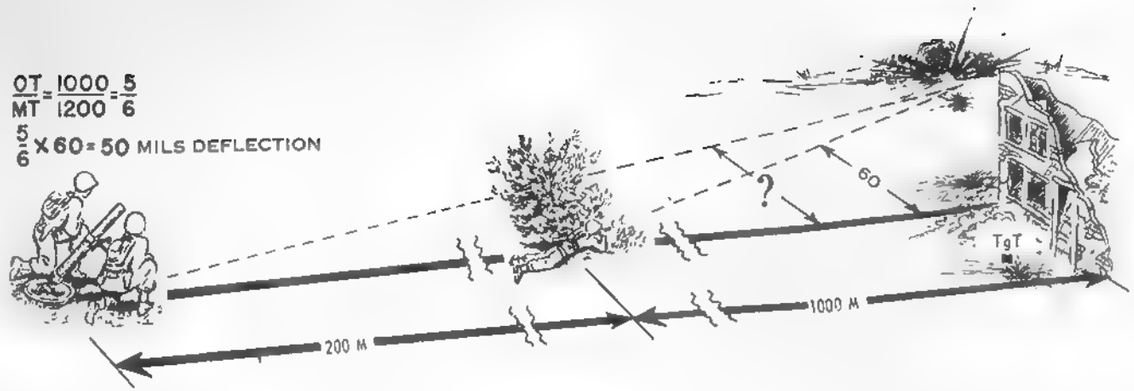


Figure 49. Observer more than 100 meters from mortar but within 100 meters of gun-target line.

e. Deflection.

f. Charge.

g. Time setting.

h. Elevation.

117. Fire Commands

a. Normal Fire Commands. The commands used in observed fire procedure without and FDC follow the procedure outlined in paragraphs 115 and 116 above, with the following exceptions:

(1) *Direction.* When operating without an FDC, the observer gives the deflection as a shift from a known point (normally the registration point) in the initial fire command. In subsequent commands, he gives the deflection correction from the last round fired. For example, during an adjustment the observer desires to move the next burst right 50 mils. Regardless of the sight setting, his command for deflection is RIGHT FIVE ZERO. The gunner arrives at the deflection to be placed on the sight by applying the LARS rule. In this case the sight has a deflection setting of 0030 mils, so the gunner subtracts 50 mils from the 0030 already on the sight and gets the new sight setting of 6380 mils. Normally, when the registration has been completed, the aiming posts are placed out on a referred deflection.

(2) *Elevation (range).* The observer may refer to a firing table, determine the charge and elevation (in mils) corresponding to the gun-target range, and announce this charge and elevation in his fire command. He may, however, announce the range in meters and have the gunner refer to a firing table to determine the charge and elevation.

b. Modified Fire Commands.

(1) Modified fire commands differ from normal fire commands only in that the deflection and elevation changes in subsequent commands are given as turns of the traversing handwheel and turns of the elevating crank. The advantages of modified fire commands are speed and simplicity of execution by the gunner. One turn of the traversing handwheel is equal to approximately 10 mils of deflection, and unabridged firing tables have a column for the number of turns of the elevation crank to change the range 100 meters. When using modified fire commands, deflection and elevation changes are computed to the nearest quarter turn. When the observer anticipates using modified fire commands involving turns of the elevating crank, he is required to announce the range element of the initial fire command as a charge and elevation. This is done to insure that the observer and gunner are working in the same charge zone, because the number of turns necessary to move the burst of a round a given distance on the ground can vary considerably between two charge zones.

(2) The gunner lays the mortar for direction and elevation as given in the initial fire command. He does not need to refer to a firing table. Following the initial fire command, he makes no attempt to aline the sight on the aiming point or to level the elevation bubble. He makes the corrections by taking the turns given in the subsequent commands and keeping the cross-level bubble centered. However, provisions should be made so that if the gunner can no longer traverse in the desired direction he may aline the sight on the aiming point, center the traversing bearing, relay on the aiming point and resume traverse.

(3) In computing the number of turns of the elevation crank between two elevations in mils (taken from the firing table), the observed subtracts the smaller elevation from the larger and divides by 10 (one turn of the elevating crank being equal to approximately 10 mils of elevation). In the ladder and bracketing methods of adjustment for range, once the observer has obtained a bracket on the target, he does not need the firing table. He continues the adjustment by splitting successively the number of turns of the elevating crank which established the preceding bracket. For example (using subsequent commands):

Modified Fire Commands	*Normal Fire Commands*
Right four turns	Right four zero
Down nine turns	One seven hundred
Left two turns	Left two zero
Up four and one-half turns	One six hundred
Right one turn	Right one zero
Down two turns	One six five zero
Three rounds	Three rounds
Up one turn	One six two five

In the above example, the first round burst between the observer and the target. In a different example, assume that the first round was fired at a range of 900 meters and burst beyond the target. The observer wants to "DROP 100" for the next round and will give a modified fire command in turns of the elevating crank. Using charge 1, the elevation for the first round at 900 meters was 1275 mils. The elevation for a range of 800 meters will be 1316 mils. Subtracting 1275 mils from 1316 mils will give a difference in elevation for the two ranges of 41 mils, or 4 turns. Therefore, the subsequent command to fire the second round will be "UP FOUR TURNS". The second round now bursts short of the target, establishing a bracket. The observer desires to split the bracket and announces "DOWN TWO TURNS," or one-half the number of turns that he previously gave to bracket the target. With this command the observer is splitting a 100-meter bracket and could therefore specify a fire for effect if he was engaging a tactical area target.

118. Fire Control

The observer controls the fire from an OP, issuing fire commands directly to the mortar crew. He may select the OP close enough to the mortar so that he can give his fire commands to the mortar crew by voice. When the OP is not close to the mortar position, the observer uses a telephone or radio to transmit fire commands.

119. Movement to Alternate and Supplementary Positions

When time and the situation permit, the mortar may be moved to both alternate and supplementary positions and registered on the registration point, final protective fire (in the defense), and as many targets as possible.

120. Squad Conduct of Fire

a. Conduct of fire includes all operations in placing effective fire on a target; for example, the observer's ability to open fire when he desires, to adjust fire, to determine the distribution of fire upon the target, to shift fire from one target to another, and to regulate the kind and amount of ammunition expended. It involves the action and teamwork of all the squad members.

b. The normal sequence of instruction is on the 1,000-inch range, followed by the training shell range, and finally, in the field with practice or combat ammunition.

c. To insure maximum efficiency, every squad member is acquainted with the principles of technique of fire for each type of adjustment and fire for effect. Frequent rotation of duty helps the squad members to get a better understanding of this technique of fire. The observer is trained in all methods and in all the techniques used in bringing effective fire on a target in the least possible time.

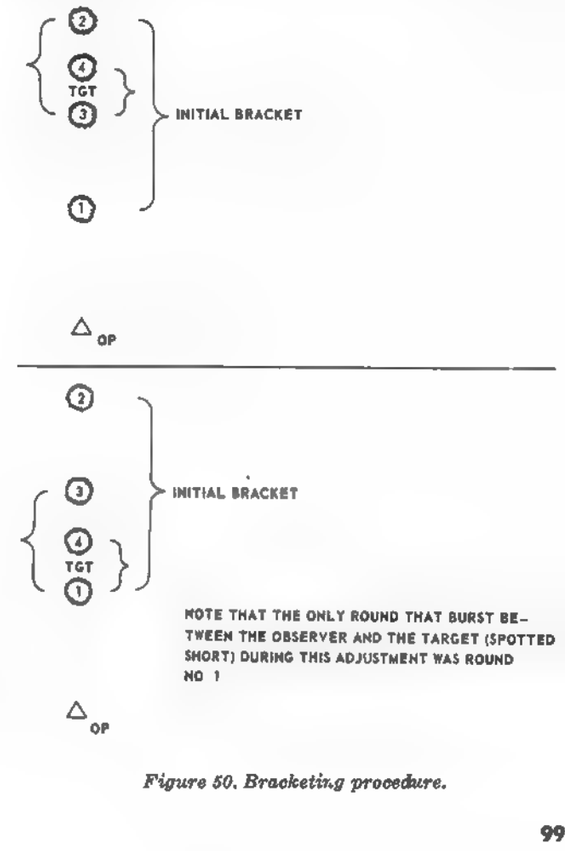


Figure 50. Bracketing procedure.

121. Establishing a Reference Line

The normal method of establishing initial direction when operating without an FDC is the direct alinement method. After initial direction has been established, the FO should conduct a registration on his registration point using only the direction stake as a reference point. After this registration is completed, a reference line should be established. To establish this reference line, aiming posts are placed out on a referred deflection, which then becomes the registration point or base deflection.

122. Fire Adjustment

The FO normally adjusts fire by the bracketing or creeping methods. He makes his spottings and gives his corrections with respect to the OT line. An off-line burst is brought to the OT line by applying a correction which is determined by multiplying the observed deviation in mils by the estimated OT distance in thousands of meters (the deflection conversion table may also be used to determine this correction). The deviation correction so determined is sent to the FDC as RIGHT or LEFT. Bursts are kept on the OT line graphically by the FDC. Range corrections in meters are sent to the FDC by the observer. Range corrections are determined along the OT line by seeking an initial range bracket and thereafter successively splitting the bracket until the correct range is determined, when using the bracketing method (para 124). When using the creeping method, the FO proceeds as in paragraph 126.

123. Adjustment of Fire Using the Bracketing Method of Adjustment

The observer can make range adjustments using the bracketing method of adjustment. In using the bracketing method of adjustment, the observer may use modified fire commands, making range changes by number of turns of the elevating crank, or by making range changes by use of the firing table.

124. Bracketing

a. The basic method of adjusting mortar fire is the bracketing method (fig 50). When engaging a new target (and a first round hit is not made) the FO establishes a bracket by obtaining a round beyond the target and a round short of the target, thereby inclosing the target within a bracket. He then successively splits the bracket (fig 50).

b. After a round has been spotted and the range is incorrect, the first range change is made large enough to insure a bracket of the target. It is better to overestimate the correction than to underestimate it because in this way a bracket is more readily obtained. The size of the initial range change is in hundreds of meters. Unless there is a definite indication as to the amount of range error, the size of the initial range change varies according to the distance from the observer to the target.

MINIMUM RANGE CHANGE GUIDE

OT Range (Meters)	*Minimum Change (Meters)*
0–999	100
1000–1999	200
2000–Over	400

The principal reasons for this guide are that at shorter distances, range estimation is more accurate, and more favorable observation of the target and the burst usually can be obtained. At greater distances, range estimation, spottings, and target observation are more difficult.

c. Once a bracket has been established, the FO continues to split that bracket until he has a 50-meter bracket. On area targets and at greater ranges, fire for effect may be delivered upon splitting a 100-meter bracket. Fire for effect is called for at the center of the smallest bracket obtained. If during the conduct of the bracket a spotting of TARGET is obtained, then the observer immediately calls for fire for effect.

d. When a bracket has been established but a subsequent round is obviously erratic because of faulty ammunition or other causes, another round is fired with the same data to prevent an erroneous correction.

e. The bracketing method of adjustment saves ammunition and time. Attempts to estimate accurately the distance between the burst and the target are seldom successful because of the inability of observers to estimate accurately the distance between two points in depth. The bracketing method eliminates the necessity for doing this. The observer merely determines whether the burst is between himself and the target or beyond the target. This method is applicable in practically all situations.

125. Adjustment of Fire Close to Friendly Troops

When engaging a target within 400 meters of friendly troops, the observer adjusts on that target using the CREEPING method. In his location of the target he adds a 200-meter safety factor to his estimated range to the target to insure that the first round does not fall short and land on friendly troops. When spotting rounds in adjustment, he estimates the overage in meters. In making the correction for range, he drops half of the estimated overage. Once he has given a correction of DROP TWO FIVE, he continues to drop 25 until he either has a TARGET, RANGE CORRECT, or SHORT spotting before firing for effect. If in the course of adjustment the observer receives a round short of the target on any correction other than 25 meters, he immediately goes into the bracketing method of adjustment.

126. Ladder Method of Adjustment

a. As surprise is an important factor in placing effective fire on a target, any form of adjustment which reduces the time interval between the burst of the first round for adjustment and fire for effect is worthy of study and use. The ladder method of adjustment, which is a modification of the bracketing method, reduces the time interval and permits fire for effect to be delivered more rapidly.

b. The procedure for firing a ladder adjustment is shown in figure 51.

(1) The observer measures the deviation of a target from the registration point as right 30 mils. He estimates the GT range as 1,475 meters. To obtain a 200-meter ladder, he adds 100 meters to this estimated range to establish one range limit for the ladder and subtracts 100 meters from the estimated range to establish the other limit. The observer will use the minimum range change guide in determining the size of the initial ladder. This should result in a ladder that straddles the target. The rounds are fired in a far, middle, and near sequence to help the observer make an accurate spotting. Since the rounds are fired in this sequence, no burst is obscured by the dust and smoke from the preceding burst. The observer checks his firing table to get the elevation for the far range, 1,600 meters (1128 mils), and the near range, 1,400 meters (1206 mils), and determines their difference in mils (78 mils; round off to 80 mils). He next computes the number of turns to place a round at the middle and near ranges. As one turn of the elevating crank depresses or elevates the barrel 10 mils, .8 turns move the barrel the required 80 mils. As one round is placed at the midpoint of these two limits (1500), the total number of turns is divided by 2. The number of turns between rounds is then 4 turns. The observer issues the following initial fire command:

SQUAD
HE QUICK
LADDER, SEARCH UP FOUR TURNS, FROM
REGISTRATION POINT, RIGHT THREE ZERO
CHARGE THREE
ELEVATION ONE ONE TWO EIGHT

(2) The method of fire element in the normal initial fire command for the ladder contains the word "ladder" and the manipulation to engage the target. The elevation element gives the elevation for the first round fired at the far range. The word "ladder" tells the gunner that three rounds will be fired as follows: the first at the elevation announced, the second after the specified manipulation, and the third after the specified manipulation. The gunner sets his sights for the proper deflection and for elevation initially at 1128 mils. He lays the mortar and fires the first round. He then searches up 4 turns, cross-levels, fires the second round, searches up 4 turns, and fires the third round. He fires the three rounds as rapidly as possible.

(3) These rounds burst as shown in figure 51. Note that the average deflection of all three rounds is left 30 mils. This is the deflection correction the gunner applies to the mortar. The three rounds falling almost simultaneously have straddled the target and, from their positions

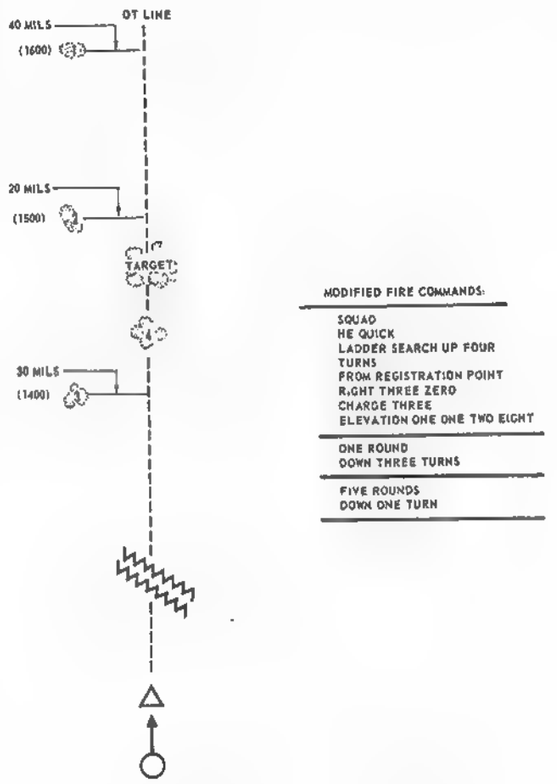


Figure 51. Ladder method of fire adjustment.

with respect to the target, indicate to the observer that the target is located between the bursting points of the second and third rounds. The observer now has a 100-meter bracket of the target. Thus, his subsequent fire command splitting the 100-meter bracket is —

ONE ROUND
RIGHT THREE TURNS
DOWN TWO TURNS

The gunner traverses right 3 turns and depresses the barrel 2 turns. He then cross-levels the mortar and fires the fourth round.

(4) The round bursts between the target and the observer and on line. The target is now bracketed between the last round fired at 1,450 meters and the second fired at 1,500 meters. The observer is now ready to fire for effect. He issues the following subsequent fire command:

FIVE ROUNDS
DOWN ONE TURN

Modified fire commands are used when employing the ladder method of adjustment. When using modified commands, the observer must remember that after the ladder is fired, the mortar is laid for elevation for the last round fired.

(5) When a 100-meter ladder is used and the target is bracketed by two of the rounds, a 50-meter bracket of the target is obtained immediately. The observer then makes a final 25-meter range change and fires for effect.

127. Squad Use of Illumination and Smoke

a. Use of Smoke. After careful evaluation of the terrain and weather, the observer locates a point on the ground where he wishes to place one flank of his screen. For example, if a flanking wind prevails, the observer normally locates the point of impact in front of the target and upwind. If necessary, the observer adjusts fire to determine the correct location of this point. For a screening mission, splitting a 100-meter bracket is normally sufficient.

b. Use of Illumination.

(1) *81-mm Mortar Illuminating Rounds.* Control over the use of infantry mortar illuminating rounds is exercised by the battalion commander after coordination with adjacent units through the next higher headquarters.

(2) *General Employment.* The correct relative position of the flare to the target depends upon the wind and the terrain. The point of burst is so placed as to give the most effective illumination on the target and to make sure that the final travel of the flare is not between the observer and the target, if possible. It is not necessary to adjust the round directly over the target due to the wide area of illumination. In the case of strong wind, the point of burst must be plaecd some distance upwind from the target so the flare drifts to the target location. Generally, the flare should be slightly to one flank of the target and at approximately the same range. When the target is on the forward slope, the flare is placed on the flank and at a slightly shorter range. For adjustment on a very prominent target, better visibility is obtained by placing the flare beyond the target to silhouette it and prevent adjustment on the target's shadow. When firing continuous illumination, a strong wind may decrease the time interval between rounds. For maximum illumination, the flare is adjusted to burn out shortly before reaching the ground.

128. Attacking Wide Targets

To attack wide targets, the observer must use distributed fire for effect. In distributed fires for effect the gunner fires a specified number of rounds, but manipulates the mortar for range or deflection between each round. To attack a wide target, the distributed fires are called traversing fire. To place traversing fire on a target, the observer must adjust fire on one end of the target, normally the end nearest to a known point.

a. After adjustment, the observer determines the width of the target in mils by using the mil scale in the binoculars, or by reading an azimuth to each end and subtracting the smaller from the larger.

b. He then divides the mil width by 10 (the number of mils that one turn of the traversing handwheel moves the mortar) to determine the number of turns necessary to traverse across the target (compute to nearest one-quarter turn).

c. In computing the number of rounds, the observer divides the width of the target by the bursting area of the round. He then divides the total number of turns by the number of intervals between the rounds to be fired, in order to determine the number of turns between rounds. (There will always be one less interval than the number of rounds fired. Compute to the nearest one-quarter turn.)

d. After adjustment and prior to issuing the subsequent fire command the observer must tell the gunner to prepare to traverse right or left. The gunner will traverse the mortar all the way over in the direction commanded and then back off two turns of the traversing handwheel. With the aid of the assistant gunner, the gunner moves the bipod legs until he is approximately re-laid on his aiming posts. Using the traversing mechanism, the gunner then completes realining the mortar and announces UP when completed.

e. When the mortar is laid the observer issues his subsequent fire command, announcing the number of rounds to be fired and the amount of manipulation between each round.

f. In figure 52 the observer measures the width of his target to be 75 mils. He estimates the range to be 2200 meters from a map. Using the mil relation formula he determines the width of the target to be 165 meters. He decides to attack the target with 5 rounds. There will be 4 intervals between the 5 rounds. Since the target is 75 mils wide he determines the number of turns to be 7 1/2 turns. To determine the number of turns between rounds he divides the number of turns by the number of intervals (7 1/2 divided by 4 = 1.87). This is rounded off to the nearest one-quarter turn. (1 3/4 turns). If you round off to the nearest one half turn you will cause a range split, due to the normal dispersion of rounds.

Note. After determining all necessary computations for a fire command, it is recommended that 2 more rounds be added for each 100 meters of target width or depth to compensate for the inherent dispersion of the rounds.

129. Attacking Deep Targets

Searching fire is used to place effective fire on targets extending in depth. To engage a target in depth, the observer must adjust on one end of the target, normally the far end. When the observer anticipates using searching fire, he announces the range as a charge and elevation.

a. After adjustment is completed on one end of the target, the observer estimates the range to the other end of the target. The firing table contains the necessary information to determine the number of turns of the elevating crank to change

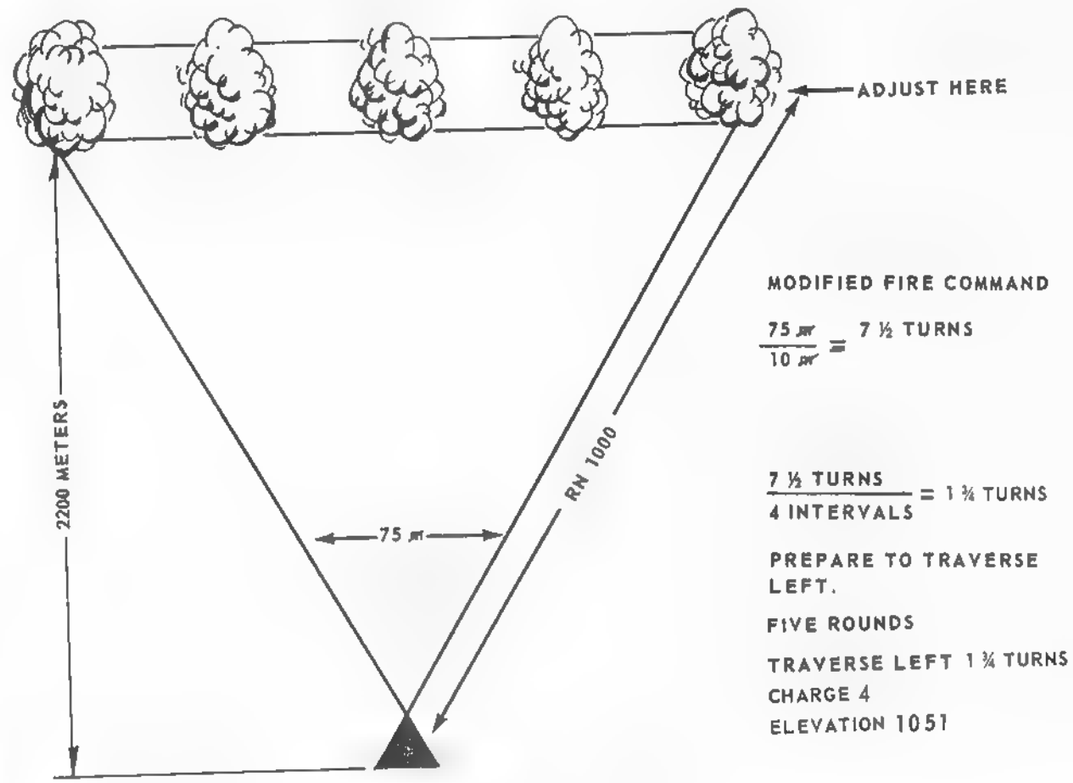


Figure 52. Traversing fire.

the range 100 meters. If for some reason the observer does not have this information, he can determine the number of turns by determining the number of mils difference in elevation that exists between the two ranges, and, by dividing the difference by 10, can determine the number of turns of the elevating crank necessary to cover the target.

b. The observer must then determine the number of rounds to be fired. As a general rule, five rounds will cover an area 100 meters deep, except at long ranges where dispersion is greater. Once he has determined the number of rounds to be fired, he determines the number of intervals between rounds. There will always be one less interval than the number of rounds fired.

c. The observer then divides the total number of turns required, by the total number of intervals, to determine the number of turns the gunner must take between each round (compute to the nearest one-quarter turn).

d. Suppose the observer has adjusted to the far end of the target, and found it to be 1,000 meters. He estimates the near edge of the target to be 950 meters. Looking at the firing table he determines that it will take five turns of the elevating crank to change the range 100 meters. Since he only wishes to make a 50-meter range change, it will require only one-half of the turns, or two and one-half. If he did not have this information, he would determine that there is a 23-mil difference in elevation for the two ranges (elevation 1231 for range 1,000, and elevation 1254 for range 950), and by dividing by 10, he determines that it would require two turns of the elevating crank. The apparent inconsistency between these two methods is because the approximate number of turns per 100 meters found in the unabridged firing tables is rounded off to the nearest turn.

e. The observer has determined that he will use three rounds to attack the target. There will be two intervals between the three rounds fired. The observer then divides the total number of turns required by the number of intervals, and rounds off the answer to the nearest one-quarter turn.

$$\frac{\text{(2 turns}}{\text{(2 intervals}} = \text{1 turn between rounds.)}$$

f. The observer is now ready to send the subsequent fire command to the gunner. The command in this example is:

THREE ROUNDS
SEARCH UP ONE TURN
ELEVATION ONE TWO THREE ONE

The gunner is told to search in the direction that the barrel moves. In this example the barrel moves from 1231 mils to 1254 mils of elevation, therefore, the command is SEARCH UP.

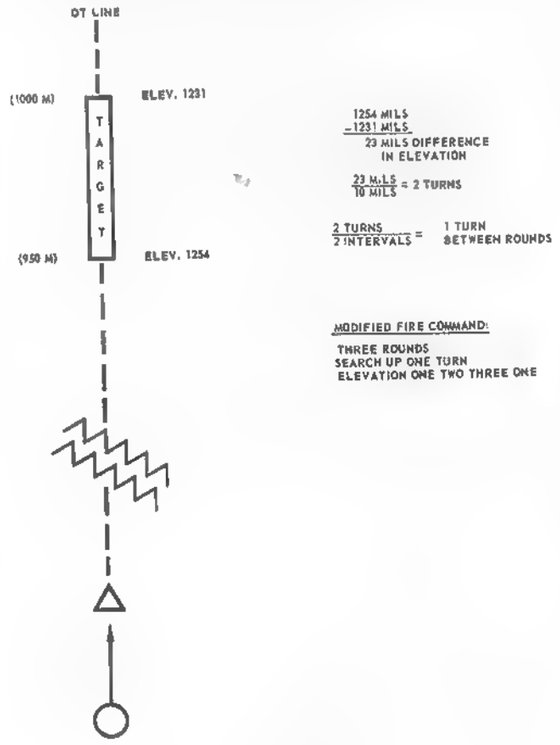


Figure 53. Searching fire.

Section II. DIRECT LAY PROCEDURE

130. General

In the direct lay method of emplacing a mortar, the gunner sees the target through the mortar sight. No directional or aiming posts are used, nor a forward observer or a fire direction center. The firing table, although not essential, should be used in an attempt to obtain a first-round hit; if the first-round hit is not achieved, the table should be used to obtain a bracket. Depending on proximity of friendly troops to the target, the bracket, modified ladder, and creeping methods of adjusting fire are applicable.

a. Advantages.

(1) Most accurate method to provide constant close-in fires for rapidly moving dismounted forces.

(2) Quickest method of placing constant, accurate fire on a moving target.

(3) By reducing fire direction personnel requirements, allows FO/FDC personnel to assist in ammunition resupply or other tasks.

(4) Allows the mortars to displace a short distance from an area under attack with minimal interruption of effective fires.

(5) Allows the mortar to continue fire support even though electronic communications have been lost with the supported maneuver element.

b. Disadvantages.

(1) Flexibility in mortar employment is reduced in that fires of the entire section can be massed less readily than when using the target-grid method.

(2) The mortar and crew are normally more vulnerable to enemy observation and direct fire weapons, depending on gun-target range and the degree of concealment which can be achieved.

(3) Ammunition resupply and distribution may be more difficult because of increased exposure of the mortar position and dispersion of the mortars.

131. Step 1 (Initial Firing Data)

a. Initial range may be determined by:

(1) Estimation.

(2) Map, photo map, etc.

(3) Intersection.

b. The elevation setting and charge selected should be obtained from a firing table. In the absence of a firing table, elevation setting and charge selection may be determined through unit SOP or by other expedient techniques, e.g., memorize charge and elevation for 1000, 2000, and 3000 meters, and fire with the charge and elevation setting closest to the estimated target range (always insure friendly troop safety).

c. Place "O" deflection on the sight.

d. Lay on the center of the target; with appropriate elevation setting on the sight, center all bubbles by adjusting the lay of the barrel. If appropriate, take actions to preclude damage to the sight, and then with established charges, fire the first round. If appropriate, replace the sight. Observe burst of the round.

132. Step 2

a. Refer the SIGHT so the VERTICAL line of the sight reticle is centered on the BURST.

b. If the burst is OVER, turn the elevating crank UP 4, 8, or 16 turns (8, the median, gives a significant change without becoming estreme), depending on the gunner's sensing of the round, range to the target, and other judgmental factors. If the burst is SHORT, turn the elevating crank DOWN 4, 8, or 16 turns.

c. Turn the SIGHT ELEVATION MICROMETER KNOB to center the ELEVATION bubble. (Should deflection change require bipod displacement, this insures that the desired range change is maintained.)

d. RE-LAY the barrel on center of target (centering both bubbles by adjusting the barrel, fire the second round, and observe the burst.

133. Step 3

a. If the second round is a line shot and brackets the target, split the bracket by changing elevation of barrel one-half the number of turns used in Step 2. (If in Step 2 the barrel was cranked up 8 turns, now crank down 4.) Fire the third round.

b. If the second round is not a line shot but does bracket the target, refer SIGHT to center of BURST, split the bracket by changing elevation of barrel one-half the number of turns used in Step 2; change SIGHT to center elevation bubble, then re-lay barrel on center of TARGET (centering both bubbles by changing lay of the barrel). Fire the third round.

c. If the second round is *not* a line shot and does *not* bracket the target, repeat Step 2 until a bracket is obtained.

134. Step 4

a. Repeat appropriate actions of Step 3 (splitting calibration/bracket) until effect on target is seen, then fire for effect.

b. After getting hits, change SIGHT to center the elevation bubble and center the vertical line of the sight reticle on the target, then record these data. Number the target and retain the number along with appropriate firing data. The mortar can now be taken out of action, moved a short distance, and then placed back into action with the mortar able to quickly and accurately (with minor changes of the barrel) attack the recorded target or other targets in its vicinity.

Note. If fired upon during any of the above steps, the mortar can be displaced 75 to 100 meters with minimal effect on the fires as long as the elevation setting for the last round fired has been recorded or memorized. Once in the new position, use the recorded/memorized data as a starting point and then complete the step which was interrupted.

APPENDIX A

REFERENCES

AR 75–1	Malfunctions Involving Ammunition and Explosives, Reports Control Symbol AMC–132 (MIN).
AR 350–4	Qualification and Familiarization With Weapons and Weapon Systems.
AR 385–63	Regulations for Firing Ammunition for Training, Target Practice, and Combat.
FM 5–15	Field Fortifications.
FM 5–25	Explosives and Demolitions.
FM 6–40	Field Artillery Cannon Gunnery.
FM 7–10	The Rifle Company, Platoons, and Squads.
FM 20–60	Battlefield Illumination.
FM 21–5	Military Training Management.
FM 23–8	U.S. Rifle 7.62-mm, M14 and M14A1.
TM 9–1015–200–12	Operator and Organizational Maintenance Manual for Mortar, 81-MM: M29A1(1015–999–7794) and Mortar; 81-MM: M29(1015–840–1836).
TM 9–1015–200–35P	Direct Support, General Support and Depot Maintenance Repair Parts and Special Tools List for Mortar, 81-MM, M29(1015–840–1836) Mortar, 81-MM: 29A1(1015–999–7794).
TM 9–1015–215–12	Operator and Organizational Maintenance Manual: Mortar, 4.2-Inch (Cannon M30 on Mount M24 or M24A1) and Mortar Subcaliber 60-mm, M31.
TM 9–1220–204–14	Operator, Organizational, Direct Support and General Support Maintenance Manual: Including RPSTL for Indirect Fire, Plotting Board M16 W/e(1220–602–7941).
TM 9–1240–278–12	Operator and Organizational Maintenance: Optical Bore Sight M45 (T151E1).
TM 9–1240–298–35	Field and Depot Maintenance Manual: Sight Units M34, M34A1, M34A2, and M34A2C.
TM 9–1300–200	Ammunition, General.
TM 9–1300–203	Artillery Ammunition for Guns, Howitzers, Mortars, and Recoilless rifles.
TM 9–6166	Operator and Organizational Maintenance Manual: Circle, Aiming M2.
TM 9–6920–212–14	Subcaliber Mortar Trainer M32 With 25-mm Training Projectile M379.
DA Pam 310–12	Index and Description of Army Training Devices.

APPENDIX B

TRAINING DEVICES

1. General

There will be times when it is not possible for a unit to conduct live fire training with the 81-mm mortar. The unit may find it is unable to schedule ranges or draw ammunition for training purposes. This appendix briefly covers training devices which allow training of the entire mortar section and suggests additional techniques that can be used for forward observation training.

2. Training Aids

a. Training Rounds. The M43A1 TP and the M68 teardrop inert training rounds can be used with limited terrain. The indirect fire team is emplaced in the normal manner. The mortar crew members can carry out all their duties in emplacing and firing the mortar; the FO teams can observe and adjust the fire by observing the rounds as they fall on the range; and the FDC personnel can compute and control the fire through normal procedures used in live fire missions. Care should be taken to locate the impact of these rounds since they can penetrate several feet into soft soil. Inert rounds are available through normal supply channels.

b. M32 Pneumatic Subcaliber Mortar Trainer. The most commonly used training device is the subcaliber mortar trainer M32, pneumatic, (fig 54), which can be safely used in large buildings or in the unit area. This device can be employed with the 60-mm, 81-mm, or 4.2-inch mortar by utilizing its various adapters. The pneumatic device is used with a miniature range with a maximum range of up to 2,000 inches. The miniature projectiles are propelled by compressed air and use a .22 caliber blank cartridge in the nose of the projectile which omits a noise and a puff of smoke. Full tanks of compressed air will allow approximately 1,200 shots. Various charges on the rounds are simulated by giving settings on the "charge setting" gage. Traversing and elevation motions are done in the normal manner. All elements of the indirect fire team can carry out their duties using this device. The pneumatic device is available from training aids centers. Ideally, the mortar crew should be positioned so that they cannot see the impact of the rounds.

c. The Bryant Device.

(1) The Bryant device (fig 55) can be used in the barracks. The device consists of a miniature range map, a tube adapter which holds a light source (usually a flashlight) centered in the bore, a barrel extension bracket which supports a mirror, and a set of miniature aiming posts. The mirror is suspended above the muzzle and is held horizontally by a plumb bob attached to the corners of the mirror. The mirror is blacked out except for a small dot of reflective area to keep the reflected light dot (the simulated fire) small on the range map. The light source provides the beam of light which is reflected onto the range map placed in front of the mortar. Through the use of crew drill, the miniature aiming posts, and simulated firing motions the mortar crew can fire the missions; the FO team can observe the fire (the dot of reflected light) and adjust the fire; and the FDC can compute for the firing just as in a live fire situation. The Bryant device can be obtained from training aids centers. (DA Pam 310–12; FSN, None; DVC No 7–6.)

(2) To place the device in operation, mount the 81-mm mortar on a magnetic azimuth (to the nearest 50 mils of the desired azimuth). This can best be done with the M2 aiming circle. Place out aiming posts in pails of sand on the floor. It is important to insure that the mount attachment ring is centered between the two white lines painted on the barrel. After the mortar is mounted as prescribed, attach the barrel extension to the mortar barrel by fitting the clamping collar around the barrel. The clamping collar must fit snugly against the shock absorber. Tighten the two clamping collar wingnuts. Place the barrel plug into the mortar barrel and insert a flashlight. Attach the plumb bob to the mirror frame by engaging the hooks in the four corner holes.

(*a*) The device is now ready for operation. Various small objects, such as match boxes, flash-

light batteries, etc., may be used to simulate targets on the floor in front of the mortar. A scale of 6 inches equal 100 meters is used to construct the target area.

(*b*) To operate the device, the forward observer is positioned to the right or left of the mortar at a minimum distance of 10 feet from the target. If he is positioned any closer than this, it becomes difficult to focus binoculars. A screen may be placed in front of the mortar so that the gun crew cannot see the target area.

(*c*) Assuming that the distance from the forward observer to the target is 10 feet and a range scale of 6 inches equal 100 meters is being used, this would make the observer target range 2,000 meters. The FO determines the azimuth to the target and formulates an initial call for fire which he transmits to the Fire Direction Center.

(*d*) When the FDC receives this request, the computer formulates an initial fire command. He determines his firing data from the M16 plotting board. A special firing table must be used for elevation to obtain the proper range. The firing table contains a simulated charge element. This can be used or omitted in the fire command.

Firing Table
Bryant Mortar Training Device

Range	Charge	Elevation	Range	Charge	Elevation
800	1	1367	1500	2	1168
825	1	1360	1525	3	1160
850	1	1355	1550	3	1154
875	1	1346	1575	3	1146
900	1	1340	1600	3	1138
925	1	1332	1625	3	1132
950	1	1325	1650	3	1125
975	1	1318	1675	3	1118
1000	1	1311	1700	3	1108
1025	2	1304	1725	3	1101
1050	2	1296	1750	3	1094
1075	2	1290	1775	3	1085
1100	2	1283	1800	3	1080
1125	2	1278	1825	3	1068
1150	2	1268	1850	3	1066
1175	2	1260	1875	3	1058
1200	2	1254	1900	3	1047
1225	2	1248	1925	3	1042
1250	2	1241	1950	3	1034
1275	2	1233	1975	3	1024
1300	2	1226	2000	3	1018
1325	2	1220	2025	4	1012
1350	2	1212	2050	4	1004
1375	2	1205	2075	4	0992
1400	2	1193	2100	4	0984
1425	2	1192	2125	4	0980
1450	2	1184	2150	4	0970
1475	2	1174	2175	4	0960
			2200	4	0950

(*e*) The gunner then receives the initial fire command from the FDC, places the announced deflection and elevation on the sight and lays the mortar accurately on the aiming posts. The gunner fires the round by turning on the flashlight and announcing, "Shot." A beam of light from the flashlight will be reflected from the mirror downward to the target area at distances that vary according to the angle of mortar elevation. Normal gunnery procedures are then followed to adjust fire.

(*f*) To make range corrections, the forward observer uses the scale that has been established (6 inches = 100 meters). To make deviation corrections, the FO uses the mil scale in his binoculars and then converts mils to meters using the mil-relation formula (WORM Formula). The range factor used in the mil-relation formula is determined by the scale.

d. Only imagination limits improvised techniques that can be used to train the indirect fire team when live fire missions cannot be conducted. In forward observation training, several commonly employed techniques are sandtable exercises, puff boards, magnetic or felt stick-on boards, and bean bags. Team drill can be used in FDC training to simulate reaction to FO calls and adjustment. Crew drill in response to the FDC's commands can be used to train the rest of the section.

e. Graphic Training Aids (GTA) are available along with training films to assist in the training of the indirect fire team.

(1) TF 7-2239—81-mm Mortar (M29) Mechanical Training and Crew Drill.

(2) TF 7-3130—81-mm Mortar M29—Part I—Mechanical Training.

(3) TF 7-3253—81-mm Mortar M29—Part II—Sight Calibration and Laying Section.

(4) T(GTA) 7-1-5—Target Grid Method of Fire Control.

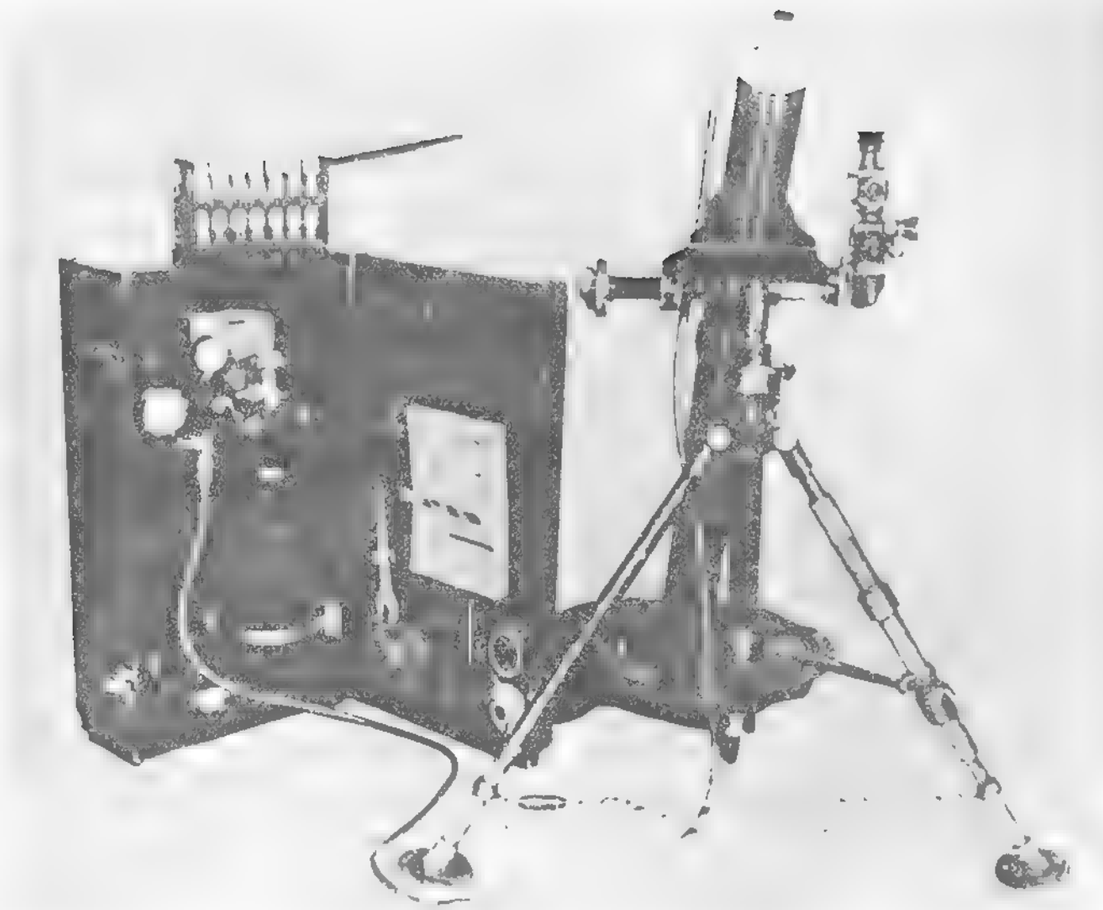


Figure 54. Subcaliber mortar trainer, M32 pneumatic.

Figure 55. Bryant device.

APPENDIX C

MORTAR ELEVATION INDICATOR

1. General

The mortar elevation indicator enables gunners to utilize the hand-held 81-mm mortar in emergency situations. When utilized with the barrel and baseplate of the standard 81-mm mortar, the gunner can effectively engage targets out to 1000 meters using either charge 0 or charge 1. The device may also be used to carry the mortar barrel (fig 56). The concept of equipping the 81-mm mortar with a combination carrying handle/elevation indicator satisfies three critical needs: rapid response, effective fires, and weight reduction. The mortar elevation indicator permits the gunner to almost instantly engage targets of opportunity.

2. Description

The device consists of an elevation indicator and an attachment ring. The elevation indicator consists of a fluid-filled longitudinal vial in which is placed a floating bead which converts the gunner's estimated range to a proper elevation of the barrel at charge 0 or charge 1. On each side of the longitudinal vial is a range scale graduated to a maximum range of 1000 meters for charge one and 400 meters for charge zero. The range scales conform to the latest data from firing tables for round HE M374, charge 0 and charge 1. The attachment ring has a clamping nut to secure the device to the mortar barrel (fig 57).

3. Installation

To install the mortar elevation indicator, the gunner removes the mount attachment ring from the barrel and does the following:

a. Slips the device down the barrel until the top of the indicator is placed on the thread below the bottom etch mark, then tightens the clamping nut.

CAUTION. DO NOT USE ANY MECHANICAL DEVICE TO TIGHTEN THE CLAMPING NUT. IT MAY CAUSE DAMAGE TO THE MORTAR BARREL. TIGHTEN FINGER TIGHT.

b. Replaces the mount attachment ring so that the bipod can be used for normal firing.

c. Insures that the etch marks are up when the barrel is in the firing position. This insures that the mortar elevation indicator does not hinder the normal mode of employment for the bipod mounted 81-mm mortar.

4. Firing the Mortar

a. In order to place the hand-held mortar into action, the gunner:

(1) Selects a position from which he can see the target and obtain mask and overhead clearance.

(2) Directs the assistant gunner to place the baseplate in the position with the open end of the socket cap in the direction of fire.

(3) Connects the barrel to the baseplate.

(4) Estimates the range to the target.

Figure 56. Carrying the mortar barrel.

Figure 57. Mortar elevation indicator.

(5) Selects a charge (either one or zero) and announces it to the assistant gunner.

(6) Lays the mortar for direction by sighting over the barrel.

Note. A WHITE LINE, EITHER CHALKED OR PAINTED ALONG THE CENTER OF THE BARREL, WILL GREATLY ASSIST THE GUNNER IN SIGHTING FOR DIRECTION.

(7) Alines the range indicator bead with the estimated range on the proper charge scale (fig 58).

(8) Directs the assistant gunner to "HANG" the round.

(9) Rechecks the lay of the weapon for direction and range and gives the command to "FIRE."

b. The assistant gunner:

(1) Places the baseplate in position for firing.

(2) Prepares the ammunition for firing.

(3) "HANGS" the round in the barrel.

(4) Drops the round on command of the gunner.

c. If a misfire occurs, the gunner and assistant gunner will take the following action:

(1) Wait for a period of 1 minute without moving the barrel or until the barrel cools.

(2) The gunner gives the barrel a quarter turn to unlock it from the baseplate and then slowly but steadily depresses the barrel to its lowest possible elevation.

(3) The assistant gunner places his hands around the muzzle to catch the round.

(4) When the assistant gunner is ready, gunner lifts the base cap until the round slides down the barrel to the assistant gunner who removes it.

5. Adjustment

a. Once the round is fired the gunner determines his lateral correction; and by moving the barrel slightly to the left or right of the target adjusts for deviation.

b. To correct for range, the gunner will elevate or depress the barrel in order to bring effective fire upon the target. When the round is over the target the gunner will elevate the mortar to compensate. Should the round land short of the target the mortar barrel is depressed to adjust on target.

Figure 58. Alining the range indicator bead.

c. The effectiveness of this fire depends upon the ability of the gunner to accurately estimate range to his target.

6. Procedure

a. The mortar elevation indicator is placed below the bottom etch mark of the barrel for three reasons:

(1) To enable the gunner to stabilize the barrel using both hands.

(2) To enable the mortar to be used in its normal configuration with the bipod without removing the elevation indicator.

(3) To be used as a carrying handle for the barrel in the normal movement.

b. The crew should be in partial defilade. This gives some protection from enemy direct fire while the gunner engages the target by direct observation of the target area. The crew can further their protection from enemy direct fire weapons by firing a round, then assuming a low silhouette with the mortar tube completely depressed. While the gunner is observing the strike of the round, the barrel remains attached to the baseplate which allows the gunner to quickly put the mortar back into action for resumption of firing.

INDEX

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

VERNE L. BOWERS,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12–11 requirements for 81-mm Mortar, M29.

* U.S. GOVERNMENT PRINTING OFFICE : 1988 O - 222-382